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THE NEW PARLIAMENT BUILDING, BERLIN.

In the accompanying engravings are represented the two prize designs for the new Capitol or Parliament Building at Berlin, of which one is by Prof. Friedrich Thiersch, of Munich, and the other by Mr. Paul Wallot, of Frankfurt a. M., the portraits of which gentlemen are also shown. The jury has decided that Mr. Wallot's design shall be executed. The building is to be erected on the Pariser Platz, near the Brandenburger Thor, in Berlin. Mr. Wallot's design will have to be somewhat changed before it can be carried out, for he has arranged the main entrance in the side of the building, and that has not satisfied the jury, as they wish to have the entrance of the Capitol more imposing. The building is provided with four corner pavilions and with a large, highly ornamented, square dome, below which the Reichsrath Chamber, or Hall of Representatives, is located. However, the most important feature of the entire design is the ground plan, which is superior to all others entered for competition. Prof Thiersch's design also has four corner pavilions, with a large circular central dome and four smaller cupolas surrounding it. The front of the building is very imposing, and is highly ornamented with statuary. An emperor's crown surmounts the central dome.

THE BRITISH SANITARY CONGRESS.

ADDRESS OF PRESIDENT GALTON.

The Congress of the Sanitary Institute of Great Britain was opened in Newcastle on September 26. The inaugural public meeting was held in the Town Hall. Prof. De Chaumont presided, in the place of the ex-President, Lord Fortescue, and introduced Captain Galton, the new President.

The President commenced his inaugural address by thanking, in the name of the Sanitary Institute of Great Britain, the Mayor and Corporation of Newcastle for the invitation to visit this important industrial metropolis of Northern England. The invitation, he said, was the more satisfactory because Newcastle was advancing in the van of sanitary improvement, and was thus proving the interest of this great city in a subject which was contributing largely to the moral and material progress of the nation. Of all the definite questions which were made the subject of the instruction by congresses at the present time, there was scarcely one which deserved a greater share of attention than that which called that congress together—namely, the subject of the public health.

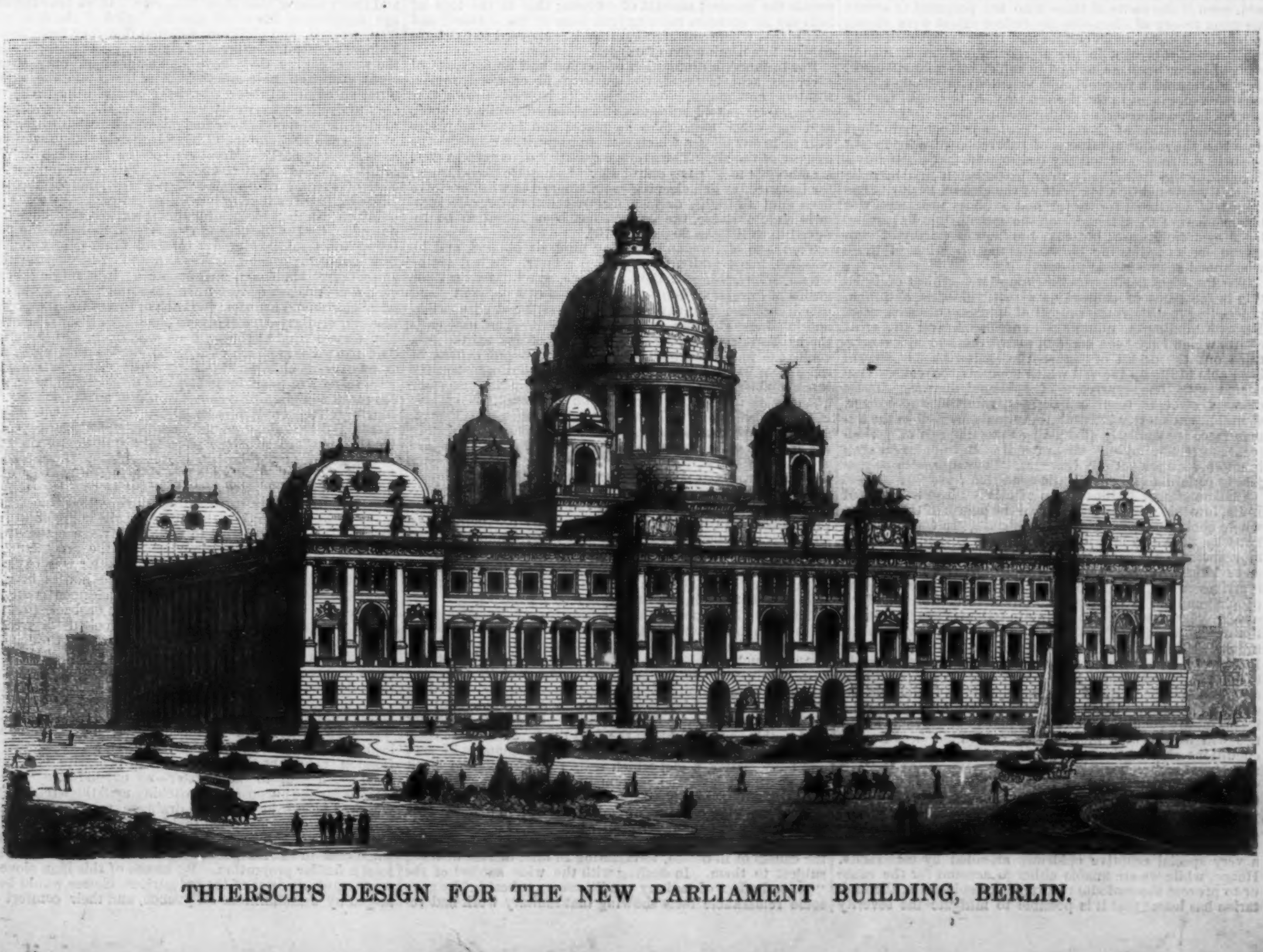
Within the last half century the whole community had been gradually awakening to the importance of a knowledge of the laws of health, and the energies of some of the ablest intellects in the world had been employed in investigating the causes of disease, and in endeavoring to solve the problem of the prevention of disease. There was much that was still obscure in this very intricate problem, but the new light which was daily being thrown upon the causes of disease by the careful and exact researches of the chemist and physiologist was gradually tending to explain those causes and to raise the science of hygiene, or science of prevention of disease, out of the region of speculation, and enable it to take rank as one of the exact sciences. Long ago the careful observation of facts had shown that the preservation of health required certain conditions to be observed in and around dwellings, conditions which, when neglected, had led to the outbreaks of epidemic disease from the days of Moses to the present time. But while the results had been patent, it was only in recent years that a clew had been obtained to the occult conditions in air and water to enable their comparative healthful purity to be distinguished.

The researches of Pasteur in respect to the forms of disease in French vineyards opened a fruitful field of inquiry, and the theories of Dr. Bastian on spontaneous generation gave rise to the beautiful series of experiments by Tyndall on bacterian life. A large band of leading scientific men, both in this country and over the whole world, were devoting their energies to a knowledge of the recent theories on the propagation of disease by germs. In a lecture on fermentation, Tyndall remarked that the researches, by means of which science has recently elucidated the causes of fermentation, have raised the art of brewing from being an art founded on empirical observation—that is to say, on the observation of facts apart from the principles which explain them—into what may be termed an exact science.

In like manner, if recent theories on the propagation of disease by germs were proved to be correct, and if the laws which govern the propagation or destruction of those germs were known, the art of the physician would be similarly raised. Upon these questions leading scientific men all over the world were devoting their energies. Research had shown that putrefaction was only another form of organized life, and Tyndall had shown that in the moving particles of fine dust discovered by a ray of light in a dark room the germs of low forms of life, which would cause putrefaction, were ever present, and ready to spring into life when a favorable "nidus" for the development of the organism was provided.

Professor Lister had turned this knowledge to useful account in surgery in causing the air to be filtered by means of a carbolic spray during surgical operations, by which means germs or organisms in the air were prevented from reaching the wounds, and from developing organisms, the

PROFESSOR FRIEDRICH THIERSCH.



THIERSCH'S DESIGN FOR THE NEW PARLIAMENT BUILDING, BERLIN.

presence of which caused putrefaction or suppuration. This antiseptic treatment, which had arisen from the observation of germs in the air, had had a material influence on the art of surgery throughout the world.

The speaker then reviewed the declarations of physiologists regarding the theories that some diseases arise from minute organisms in the blood—Pasteur holding that the disease in silkworms was from this cause; Dr. Davaine, that splenic fever in cattle arose thus; Dr. Klein alleging that pig typhoid was due to an organism; Toussaint attributing fowl cholera to a similar cause; Professor Koch attributing tubercular disease to specific germs; Dr. Vandyke Carter contending that there was a connection between the presence of bacillus spirillum and relapsing fever; and Mr. Talamon claiming to have discovered that diphtheria was due to an organism by means of which the virus could be conveyed from human beings to animals, and *vice versa*.

Taking another branch of the same subject, the causes of zymotic diseases being traced to controllable sources, he said: Drs. Klebs and Crudelli allege that malarial fever arises from germs present in the soil and which float over the air of marshes; and that by treating with water the soil of a fever-haunted marsh of the Campagna the germs of this organism could be washed out; and that the water containing the organisms thus obtained, introduced into the circulation of a dog, produced ague more or less rapidly, and more or less violent, according to the numbers in which the organisms were present in the water.

This theory, no doubt, agrees with certain well-known facts. In a tropical climate, if soil which has been long undisturbed, or the soil of marshy ground, be turned up, intermittent fever is almost certain to ensue. In illustration of this, I recollect that at Hong Kong the troops were unhealthy, and a beautiful position on a peninsula exposed to the most favorable sea-breezes was selected for a new encampment. The troops were encamped upon this spot for some time to test its healthiness, which was found to be all that could be desired. It was then resolved to build barracks. As soon as the foundations were dug, fever broke out.

As an instance of this nearer home, I may mention that last winter at Cannes, in the south of France, some extensive works adjacent to the town were begun which required a large quantity of earth to be moved. The weather was exceptionally warm; an outbreak of fever occurred among the workmen, of whom fifteen died. This fever was attributed to the turning up of the soil.

If a strong solution of quinine be let fall in the water containing these organisms they at once die; the efficacy of quinine as a preventive of this form of fever would therefore not be inconsistent with this theory. Upon this subject the President called attention to the view of Sir Joseph Fayrer, who acknowledged the importance of the discovery if it should be confirmed, but considered that there was a possibility that the results attributed to these influences might, to some extent, be due to disturbance of the system in a body predisposed to be deranged by peculiarity of constitution, climatic or other influence of the nature of which we are ignorant, though it is conceivable by analogy.

The marvelous facility of reproduction of various germs, as shown by Pasteur in the case of chicken cholera, was dwelt upon; and the President said that it would be a wonder how any higher form of life could exist subject to the possibility of invasion by such countless hosts of occult enemies were it not seen that the science of the prevention of disease advanced quite as rapidly as our knowledge of the causes. Holding that the attitude of the sanitarian, in regard to the germ theory of diseases, as applied to all diseases of the zymotic class, must be one of reserve, yet, he said, even if the views of those who are prepared to accept the germ theory of disease to its fullest extent were shown to be true, it seems to be certain that if the invasion of these occult enemies present in the air is undertaken in insufficient force, or upon an animal in sufficiently robust health, they are refused a foothold and expelled; or, if they have secured a lodgment in the tissues, they, so to speak, may be laid hold of, and absorbed or digested by them.

In corroboration of this view, Professor Koch and others state that the minor organisms of tubercular disease do not occur in the tissues of healthy bodies, and that when introduced into the living body their propagation and increase is greatly favored by a low state of the general health. The President held that for the present sanitary procedure was independent of these theories on the germ origin in particular of zymotic disease; but gave the facts as worthy of consideration, as indicating points for the direction of those who aimed at preventing disease.

The President dealt with the important subject of isolation in the cases of contagious zymotic diseases, and then, proceeding to discuss the subject of epidemic diseases, said: Notwithstanding the numerous experiments and the great efforts which have been made in recent times to endeavor to trace out the origin of disease, the sanitarian has not yet been able to lift up the veil which conceals the causes connected with the occurrence of epidemic diseases. These diseases come in recurring periods, sometimes at longer, sometimes at shorter intervals. Animals, as well as the human race, are similarly affected by these diseases of periodical recurrence; but why they prevail more in one year than in another we are entirely ignorant. They appear to be subject to certain aerial or climatic conditions.

Cholera affords an illustration of this. There is a part of India, low-lying, water-logged, near the mouth of the Ganges, where cholera may be said to be endemic. In certain years, but why we know not, it spreads out of this district, and moves westward over the country; the people are sedentary, and seldom leave home, but the cholera travels on. At last it arrives on the borders of the desert, where there are no people, and no intercourse, no alvine secretions, and no sewers, yet the statistician sitting in Calcutta can tell almost the day on which the epidemic influence will have crossed the desert. But it exercises discrimination in its attacks. It will visit one town or village and leave many others in the vicinity untouched. Similarly it will attack one house and leave another. But it has been generally found that the attacked house or village held out special invitation from its insanitary condition. The same houses or the same localities will be revisited in recurring epidemics, because the conditions remain the same; remove those conditions, and at the next recurrence the locality will escape. At Malta it was found that the same localities and houses which yielded the majority of plague deaths there in 1813 yielded the majority of the deaths in the cholera epidemics of 1839 and 1867, and that in the intervals the same localities yielded the majority of cases of small-pox, fever, and of an anthrax, a very special eruptive epidemic attended by carbuncles. Hence, while we are unable either to account for the cause or to prevent the periodic recurrence of epidemics, the sanitarian has learnt that it is possible to mitigate the severity of the visit; and that, whether these evils arise from the occult causes to which I have alluded, or from other causes, pure air and pure water afford almost absolute safeguards against most forms of zymotic diseases.

In speaking of the pure-water question, he remarked: Although there are many theories as to how far water which has once been contaminated by sewage may again after a time become fit to drink, I am disposed to think that there has never been a well-proved case of an outbreak of disease resulting from the use of drinking water where the chemist would not unhesitatingly on analysis have condemned the water as an impure source; and it appears probable that, whatever may be the actual causes of certain diseases—*i. e.*, whether germs or chemical poisons, the *materies morbi* which finds its way into the river at the sewage outfall is destroyed, together with the organic impurity, after a certain length of flow. He pressed that there should be no further delay in bringing the Act for the Prevention of Pollution of Rivers into operation, and in enforcing the provisions of the Acts. In regard to the pollution of the air, he called attention to the fact that nearly fifty years ago Mr. Edwin Chadwick impressed upon the community the evils which were caused by the impure condition of the air in our towns owing to the retention of refuse around houses. The speaker remarked that the gases, which were the result of putrefaction, were offensive to the smell, and some of them, such as sulphureted hydrogen, when present in undue proportions in the air, would kill persons outright, or when those gases were in smaller proportions in the air breathed by people, there would be a lowered tone of health in the individuals exposed to them. Continued exposure might lead to the development of other conditions, which, in their turn, might lead to disease or death.

From this point the President proceeded to speak of the increased toxical power of volatile compounds given off by neglected decomposed matter, and was thence led to dwell upon the dangers arising from decomposed substances in cesspools and in badly constructed drains. There was no doubt, he said, that in the sewering of towns want of experience in the construction of works had in some cases led to deposits in the sewers, and evil consequences had ensued; but it might be accepted as certain that in every case where the sewerage had been devised on sound principles, and where the works had been carried on under intelligent supervision, a largely reduced death-rate had invariably followed.

Evidence of this fact he adduced from the history of Newcastle, for in the ten years beginning in 1867 the death-rate was 27·6, while in the ten years ending 1881 (during which there had been improved sewerage in operation) the death-rate was only 23, while in 1881 it was only 21·7. He instanced the like results in Munich, where the entire fever mortality sank from 24·2 in the period when there were no regulations in regard to cleanliness to 8·7 when the sewerage was complete, at Frankfort-on-the-Main, at Dantzic, and at Hamburg, where similar results obtained of a heavy zymotic mortality previous to the sewering of the cities, and a lighter mortality on the completion of the works.

These results were set forth in figures, and after dealing with the beneficial results of purifying the air of towns by the rapid abstraction of refuse matter, he passed on to review "other fertile causes of mischief" in poisoning the air of towns, the chief of these being horse manure, the dust of refuse, and smoke.

On this subject he quoted Dr. Angus Smith, who in his "Contributions to the Beginnings of a Chemical Climatology," shows that the air in the middle of the Atlantic Ocean, on the sea-shore, and on uncontaminated open spaces, commands the greatest amount of oxygen; that at the tops of hills the air contains more oxygen than at the bottom; and that places where putrefaction may be supposed to exist are subject to a diminution of oxygen.

For instance, a diminution of oxygen and an increase of carbonic acid is decidedly apparent in crowded rooms, theaters, cowhouses, and stables. It is well known that oxygen over putrid substances is absorbed, while carbonic acid and other gases take its place; and hence all places near or in our houses which contain impurities diminish the oxygen of the air. The average quantity of oxygen in pure air amounts to 21 parts out of 100. In impure places, such, for instance, as in a sleeping-room where the windows have been shut all night, or in a lecture-theater after a lecture, or in a close stable, the oxygen has been found to be reduced to as little as 20 parts in 100.

That is to say, a man breathing pure air obtains, and he requires, 2,164 grains of oxygen per hour. In bad air he would, if breathing at the same rate, get little over 2,000 grains of oxygen an hour—that is, a loss of 5 per cent.; and this diminished quantity of oxygen is replaced with other, and in almost all cases, pernicious matters. The oxygen is the hard-working, active substance that keeps up the fire, cooks the food, and purifies the blood; and, of course, as the proportion of oxygen in the air breathed diminishes, the lungs must exert themselves more to obtain the necessary quantity of oxygen for carrying on the functions of life. If the air is loaded with impurities the lungs get clogged, and their power of absorbing the oxygen that is present in the air is diminished. An individual breathing this impure air must therefore do less work; or, if he does the same amount of work, it is at a greater expense to his system.

The influence of smoky town air on health is to some extent illustrated by the fact that the death-rate of twenty-three manufacturing towns, selected chiefly for their smoky character, averaged 21·9 per 1,000 in 1880; while the rural districts in the counties of Wilts, Dorset, and Devon, excluding large towns, averaged 17·7 per 1,000; and the deaths from the principal zymotic diseases in the towns were more than double those in the rural districts.

The President quoted the experiments of Mr. Aitkin, of Edinburgh, on the creation of fogs—that the vapor of water injected into air, from which particles had been strained out, was not visible; whereas as soon as foreign matter, such as dust, or smoke, or fumes, and especially fumes of sulphur, were introduced, the aqueous vapor condensed on the particles, and became visible as fog, and pointed out the fact that the barbarous method which we adopt for burning coal in this country adds to the dust the fumes which necessarily result from combustion, as well as a quantity of soot and tarry matter, a soot which assists in forming the black canopy which it is the fashion in England to consider the proper attribute of a large town.

He quoted the opinions of eminent scientific men to show that it was possible, under proper methods of burning coal, to lessen the intensity of fogs, and so to lessen materially the causes of ill-health, terminating in fatal disease of those subject to them. In dealing with the wide subject of the "general effect of sanitary conditions upon health," he gave some remarkable facts showing that sanitary work had reduced the death-rate of the European army in India from 60 per 1,000 to 16 per 1,000; that the deaths from tubercular disease in the army at home used to be 10 per 1,000—the sum total now of the total deaths from all causes in a time of peace—a reduction due to the improved hygienic conditions under which soldiers now live; that the death-rate in a certain part of Newcastle (now removed) used to be 54 per 1,000, and of the entire borough 26·1 so lately as seven years ago, while now it was 21·8; that in parts of London, where the people were ill-lodged and crowded, as in parts of Limehouse, Whitechapel, Aldgate, and St. Giles's, the death-rates were 50 per cent. above the death-rates in more open parts of the same districts, and that when proper dwellings were erected the death-rates fell from 50 in the 1,000 to not more than 20 per 1,000. He then spoke of the advantage arising to the health of the population generally by the new dwellings for artisans.

He remarked that these improved dwellings "afford accommodation to a population per acre as dense as, and in most cases even denser than, that afforded by the buildings which they replaced. Within limits it is not the density of population which regulates the health. But if a dense population is spread over the surface or close to the surface of the ground, by which means all movement of air is prevented, and if there are numerous corners in which refuse is accumulated, it will be difficult to prevent disease. Dr. Angus Smith's experiments show that while there is less oxygen and more carbonic acid in the eastern and in the more crowded parts of London, yet in open spaces the amount of oxygen rises and the carbonic acid diminishes very considerably; and that we are exposed to distinct currents of good air in the worst, and equally to currents of bad air in the best atmosphere, in towns like Manchester.

Dr. Tyndall showed that where there is quiescence in the air the tendency of his sterilized infusions to produce organisms was increased. The conclusion from all these experiments is to show the importance of laying out the general plan of dwellings in a town so that currents of air shall be able to flow on all sides with as little impediment as possible, by which means the air will be continually liable to renewal by purer air. The dwellings which have been constructed in the place of the very defective dwellings condemned by the medical officers of health in various parts of London specially illustrate the importance of this question of the circulation of air. These dwellings replace those in which the normal mortality was as much as 33, 44, and 50 per 1,000. But these improved dwellings provide ample space all round the blocks of building, so that air can flow round and through them in every direction, and so that there are no narrow courts and hidden corners for the accumulation of refuse. The mortality in the new dwellings is as low as 13 per 1,000 in some, and does not rise above 20 per 1,000 in any of them, and upon an average of years it may be taken at from 14 to 16 per 1,000. It is to this point that I specially desire to draw attention—namely, that these facts prove the possibility of bringing down the death-rate of the class of population which inhabits this sort of accommodation to rates varying from 15 to 16 per 1,000. I say of the class of population, because habits and mode of life have an important influence on health and on longevity.

Mr. Chadwick and Dr. Richardson obtained some statistics for Westminster, for the use of a committee of the Society of Arts, which indicate the very different conditions of health to which the different classes of population are subject. It appeared from these statistics that out of one hundred deaths of the first class, or gentry, six were those of children in their first year, and nine of children within their fifth year; while out of one hundred deaths of the wage classes twenty-two are those of children in their first year, and thirty-nine within their fifth year. If we take the average duration of life of all who have died of the first class, men, women, and children, we find that they have had an average of fifty-five years and eight months of life; while of the wage classes they have had a mean of only twenty-eight years and nine months. And if we take the average duration of life of those who have escaped the earlier ravages of death up to twenty years of age, the males who have died of the first class have had sixty-one years of life, while of the wage class the males have had only forty-seven years and seven months. Moreover, of the first class in Westminster, the proportion who have attained the old age, and died of natural causes, is 3·27 per cent., but of the wage classes only a fraction, or two-thirds per cent., did so. I have obtained similar returns for this town. It was considered desirable, for the purpose of this return, to divide the population into the following five classes: First, gentry and professional men; second, tradesmen and shopkeepers; third, shipwrights, chain and anchor smiths, iron forge laborers, etc., fourth, seamen, watermen, fishermen, etc.; fifth, other wage classes and artisans; and each of these classes represents distinct sanitary conditions and habits of life. The healthiest class is that of the seamen, watermen, and fishermen. The mean age at death of all who died of that class, men, women, and children, is thirty-seven years, as compared with thirty five years for gentry and professional men; while the mean age of shipwrights, chain and anchor makers, and iron forge laborers is only twenty-two years. The President considered that these points gave much food for reflection. He then touched upon the important question of the effect of occupation upon health, and remarked: If we take the professional and merchant class, who attend at their offices during the daytime, we may be sure that, as a rule, they are placed in unhealthy surroundings during that time, and in many cases have to breathe during their hours of work as bad an atmosphere as that in which the wage classes work. He also quoted returns showing that the great mortality among the tradesmen class in Westminster was explained from the fact that the best rooms in the houses in which they live were let for lodgings, the tradesmen contenting themselves with living in the basements or back premises, which were frequently unhealthy. He looked for great improvements in the health of the wage classes by the construction of improved dwellings; but, he confessed, in many cases workmen required to be taught to attend to precautions devised for their health.

On the subject of sickness caused by insanitary conditions, he quoted the remark of an East London clergyman that the "poor go on living in wretched places, but have much ill-health." He showed from Mr. Burdett's figures that the London voluntary hospitals and dispensaries cost nearly £600,000 a year to administer—an expenditure incurred mainly for the purpose of "patching up" the wretched poor who had been injured by bad drainage, want of ventilation and the like; and he urged that it might be safely assumed preventive measures would bring down the death-rate of the wage class to one-half, reducing also the sickness rate in at least a similar proportion. By means of this item alone the wage-earning power of the industrious classes would be enlarged by some millions of pounds, and their comfort cor-

respondingly increased. There would also, he contended, be other distinct economies, for there would be less need for much of the accommodation in prisons, reformatories, and workhouses now needed from evils incident to unhealthy circumstances and crowded dwellings.

He dwelt upon the economic advantages of sanitary measures generally, dealing first with the subject of the conversion of sewage into manure, and then, in relation to the provision of healthful dwellings, such as those of the Metropolitan Association for Improving the Dwellings of the Industrial Classes, he showed that the cost of such dwellings had been about £1,900,000 for 11,000 persons. By the saving in life and health, through the continuance in earning power of men, whose lives would otherwise have been cut short, he estimated that the expenditure of the £1,900,000 for the 11,000 persons, by the addition of ten years' earning power to the heads of families, brought in a return of £4,000,000, and urged these facts as showing the pecuniary advantages accruing to the nation from sanitary improvements which led to decreased death and sickness rates. On the one hand, he said, insanitary dwellings and insanitary conditions of life engendered sickness, entailed poverty, and fostered crime, while improved dwellings insured improved health, and by affording a security for the more continuous earning of wages created the possibility of a comfortable home. Advanced sanitarians had long preached these doctrines, and he was happy to think that they were at last beginning to hear some results, and in those results he saw the means of developing morality, contentment, and happiness among the people.

[NATURE.]

PSYCHOLOGICAL DEVELOPMENT IN CHILDREN.*

THIS is a large octavo volume, extending to over four hundred pages, and consisting of daily observations without intermission of the psychological development of the author's son from the time of birth to the end of the first year, and of subsequent observations less continuous up to the age of three years. Professor Preyer's name is a sufficient guarantee of the closeness and accuracy of any series of observations undertaken with so much earnestness and labor, but still we may remark at the outset that any anticipation which the reader may form on this point will be more than justified by his perusal of this book. We shall proceed to give a sketch of the results which strike us as most important, although we cannot pretend to render within the limits of a few columns any adequate epitome of so large a body of facts and deductions.

The work is divided into three parts, of which the first deals with the development of the senses, the second with the development of the will, and the third with the development of the understanding.

Beginning with the sense of sight, the observations show that light is perceived within five minutes after birth, and that the pupils react within the first hour. On the second day the eyes are closed upon the approach of a flame; on the eleventh the child seemed to enjoy the sensation of light; and on the twenty-third to appreciate the rose color of a curtain by smiling at it. Definite proof of color discrimination was first obtained in the eighty-fifth week, but may, of course, have been present earlier. When seven hundred and seventy days old the child could point to the colors yellow, red, green, and blue, upon these being named.

The eyelids are first closed to protect the eyes from the sudden approach of a threatening body in the seventh or eighth week, although, as already observed, they will close against a strong light as early as the second day. The explanation of their beginning to close against the approach of a threatening body is supposed to be that an uncomfortable sensation is produced by the sudden and unexpected appearance, which causes the lids to close without the child having any idea of danger to its eyes; and the effect is not produced earlier in life because the eyes do not then see sufficiently well. On the twenty-fifth day the child first definitely noticed its father's face; when he nodded or spoke in a deep voice, the child blinked. This Professor Preyer calls a "surprise-reflex;" but definite astonishment (at the rapid

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opening and closing of a fan) was not observed till the seventh month. The gaze was first fixed on a stationary light on the sixth day, and the head was first moved after a moving light on the eleventh day; on the twenty-third day the eyeballs were first moved after a moving object without rotation of the head; and on the eighty-first day objects were first sought by the eyes. Up to this date the motion of the moving object must be slow if it is to be followed by the eyes, but on the one hundred and first day a pendulum swinging forty times a minute was followed. In the thirty-first week the child looked after fallen objects, and in the forty-seventh purposely threw objects down and looked after them. Knowledge of weight appeared to be attained in the forty-third week. Persons were first distinguished as friends or strangers in the sixth month, photographs of persons were first recognized in the one hundred and eighth week, and all glass bottles were classified as belonging to the same genus as the feeding-bottle in the eighth month.

With regard to the sense of hearing, it is first remarked that all children for some time after birth are completely deaf, and it was not till the middle of the fourth day that Professor Preyer obtained any evidence of hearing in his child. This child first turned his head in the direction of a sound in the eleventh week, and this movement in the sixteenth week had become as rapid and certain as a reflex. At eight months, or a year before its first attempts at speaking, the infant distinguished between a tone and a noise, as shown by its pleasure on hearing the sounds of a piano; after the first year the child found satisfaction in itself striking the piano. In the twenty-first month it danced to music, and in the twenty-fourth imitated song; but it is stated on the authority of other observers that some children have been able to sing pitch correctly, and even a melody, as early as nine months. One such child used at this age to sing in its sleep, and at nineteen months could beat time correctly with its hand while singing an air.

Concerning touch, taste, and smell, there is not so much to quote, though it appears that at birth the sense of taste is best developed, and that the infant then recognizes the difference between sweet, salt, sour, and bitter. Likewise, passing over a number of observations on the feelings of hunger, thirst, satisfaction, etc., we come to the emotions. Fear was first shown in the fourteenth week; the child had an instinctive dread of thunder, and later on of cats and dogs, of falling from a height, etc. The date at which affection and sympathy first showed themselves does not appear to have been noted, though at twenty-seven months the child cried on seeing some paper figures of men being cut with a pair of scissors.

In the second part of the book it is remarked that voluntary movements are preceded, not only by reflex, but also by "impulsive movements," the ceaseless activity of young infants being due to purposeless discharges of nervous energy. Reflex movements are followed by instinctive, and these by voluntary. The latter are first shown by grasping at objects, which took place in Preyer's child during the nineteenth week. The opposition of the thumb to the fingers, which in the ape is acquired during the first week, is very slowly acquired in the child, while, of course, the opposition of the great toe is never acquired at all; in Preyer's child the thumb was first opposed to the fingers on the eighty-fourth day. Up to the seventeenth month there is great uncertainty in finding the mouth with anything held in the hand—a spoon, for instance, striking the cheeks, chin, or nose, instead of at once going between the lips; this forms a striking contrast to the case of young chickens which are able to peck grains, etc., soon after they are hatched. Sucking is not a pure reflex, because a satisfied child will not suck when its lips are properly stimulated, and further, the action may be originated centrally, as in a sleeping suckling. At a later stage biting is as instinctive as sucking, and was first observed to occur in the seventeenth week with the toothless gums. Later than biting, but still before the teeth are cut, chewing becomes instinctive, and also licking. Between the tenth and the sixteenth week the head becomes completely balanced, the efforts in this direction being voluntary and determined by the greater comfort of holding the head in an upright position. Sitting up usually begins about the fourth month, but may begin much later. In this connection an interesting remark of Dr. Lauder Brunton is alluded to ("Bible and Science," page 239), namely, that when a young child sits upon the floor the soles of his feet are turned inward facing one another, as in the case with monkeys. When laid upon their faces children at earliest

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* *Die Seele des Kindes. Beobachtungen ueber die geistige Entwickelung des Menschen in den ersten Lebensjahren.* Von W. Preyer, ordentlichen Professor der Physiologie an der Universitaet und Director des physiologischen Instituts zu Jena, etc. Leipzig: Th. Grieben. 1882.

MR. P. WALLOT'S DESIGN FOR THE NEW PARLIAMENT BUILDING, BERLIN.

can right themselves during the fifth month. Preyer's child first attempted to stand in the thirty-ninth week, but it was not until the beginning of the second year that it could stand alone, or without assistance. The walking movements which are performed by a child much too young to walk, when it is held so that its feet touch the ground, are classified by Preyer as instinctive. The time at which walking proper begins varies much with different children, the limits being from eight to sixteen months. When a child which is beginning to walk falls, it throws its arms forward to break the fall; this action must be instinctive. In the twenty-fourth month Preyer's child began spontaneously to dance to music and to beat time correctly.

A chapter is devoted to imitative movements. At the end of the fifteenth week the child would imitate the movement of protruding the lips, at nine months would cry on hearing other children do so, and at twelve months used to perform in its sleep imitative movements which had made a strong impression while awake—*e. g.*, blowing; this shows that dreaming occurs at least as early as the first year. After the first year imitative movements are more readily learned than before.

Shaking the head as a sign of negation was found by Preyer, as by other observers, to be instinctive, and he adopts Darwin's explanation of the fact—viz., that the satisfied suckling in refusing the breast must needs move its head from side to side. In the seventeenth month the child exhibited a definite act of intelligent adjustment, for, desiring to reach a toy down from a press, it drew a traveling-bag from another part of the room to stand upon. We mention this incident because it exhibits the same level of mental development as that of Cuvier's orang, which, on desiring to reach an object off a high shelf, drew a chair below the shelf to stand upon. Anger was expressed in the tenth month, shame and pride in the nineteenth.

Between the tenth and eleventh month the first perception of causality was observed. Thus on the three hundred and nineteenth day the child was beating on a plate with a spoon and accidentally found that the sound was damped by placing the other hand upon the plate; it then changed its hands and repeated the experiment. Similarly at eleven months it struck a spoon upon a newspaper, and changed hands to see if this would modify the sound. In some children, however, the perception of causality to this extent occurs earlier. The present writer has seen a boy when exactly eight months old deriving much pleasure from striking the keys of a piano, and clearly showing that he understood the action of striking the keys to be the antecedent required for the production of the sound.

The third part of the book is concerned, as already stated, with the development of the understanding. Here it is noticed that memory and recognition of the mother's voice occurs as early as the second month; at four months the child cried for his absent nurse; and at eighteen months he knew if one of ten toy animals were removed. In Preyer's opinion —and we think there can be no question of its accuracy—the intelligence of a child before it can speak a word is in advance of that of the most intelligent animal. He gives numerous examples to prove that a high level of reason is attained by infants shortly before they begin to speak, and therefore that the doctrine which ascribes all thought to language is erroneous.

Highly elaborate observations were made on the development of speech, the date at which every new articulate sound was made being recorded. The following appear to us the results under this head which are most worth quoting.

Instinctive articulation without meaning may occur as early as the seventh week, but usually not till the end of the first half year. Tones are understood before words, and vowel sounds before consonants, so that if the vowel sounds alone are given of a word which the child understands (thirteen months), it will understand as well as if the word were fully spoken. Many children before they are six months old will repeat words parrot-like by mere imitation, without attaching to them any meaning. But this "echo-speaking" never takes place before the first understanding of certain other words is shown—never, *e. g.*, earlier than the fourth month. Again, all children which hear but do not yet speak, thus repeat many words without understanding them, and conversely, understand many words without being able to repeat them. Such facts lead Professor Preyer to suggest a somewhat elaborate *schema* of the mechanism of speech, both on its physiological and psychological aspects; but this *schema* we have not sufficient space to reproduce.

Although the formation of ideas is not at first, or even for a considerable time, dependent on speech (any more than it is in the case of the lower animals), it constitutes the condition to the learning of speech, and afterward speech reacts upon the development of ideation. A child may and usually does imitate the sounds of animals as names of the animals which make them long before it can speak one word, and, so far as Preyer's evidence goes, interjections are all originally imitative of sounds. Children with a still very small vocabulary use words metaphorically, as "tooth-heaven" to signify the upper gums, and it is a mistake to suppose that the first words in a child's vocabulary are invariably noun-substantives, as distinguished from adjectives or even verbs. As this statement is at variance with almost universal opinion, we think it is desirable to furnish the following corroboration. The present writer has notes of a child which possessed a vocabulary of only a dozen words or so. The only properly English words were "poor," "dirty," and "cook," and of these the two adjectives, no less than the noun-substantive, were always appropriately used. The remaining words were nursery words, and of these "ta-ta" was used as a verb meaning to go, to go out, to go away, etc., inclusive of all possible moods and tenses. Thus, for instance, on one occasion, when the child was wheeling about her doll in her own perambulator, the writer stole away the doll without her perceiving the theft. When she thought that the doll had had a sufficiently long ride, she walked round the perambulator to take it out. Not finding the doll where she had left it she was greatly perplexed, and then began to say many times "poor Na-na, poor Na-na," "Na-na ta-ta, Na-na ta-ta;" this clearly meant—poor Na-na has disappeared. And many other examples might be given of this child similarly using her small stock of adjectives and verbs correctly.

According to Preyer, from the first week to the fifth month the only vowel sounds used are *ä* and *a*. On the forty-third day he heard the first consonant, which was *m*, and also the vowel *e*. Next day the child said *ta hu*, on the forty-sixth day *gö. örö*, and on the fifty-first *arra*. All the vowel sounds were acquired in the fifth month. We have no space to go further into the successive dates at which the remaining consonants were acquired. In the eleventh month the child first *learnt* to articulate a certain word (*ada*) by imitation, and afterward repeated the taught word spontaneously. The first year passed without any other indication of a connection between articulation and ideation than was supplied by the child using a string of different syllables (and not merely a repetition of the same one) on perceiving a rapid movement, as any one hurriedly leaving the room, etc.; but this child nevertheless understood certain words (such as "handchen geben") when only fifty-two weeks old. Inefficient attempts at imitative speaking precede the accurate attempts, and at fourteen months this inefficiency was still very apparent, being in marked contrast with the precision whereby it would imitate syllables which it could already say; the *will* to imitate all syllables was present, though not the *ability*. At the beginning of the fourteenth month on being asked: "Wo ist dein Schrank?" the child would turn its head in the direction of the cupboard, draw the person who asked the question toward it (though the child could not then walk); and so with other objects the names of which it knew. During the next month the child would point to the object when the question was asked, and also cough, blow, or stamp on being told to do so. In the seventeenth month there was a considerable advance in the use of sign-language (such as bringing a hat to the nurse as a request to go out), but still no words were spoken save *ma-ma*, *pa-pa*, etc. In the twentieth month the child could first repeat words of two unlike syllables. When twenty-three months old the first evidence of judgment was given; the child having drunk milk which was too hot for it, said the word "heiss." In the sixty-third week this word had been learnt in imitative speaking, so it required eight and a half months for it to be properly used as a predicate. At the same age on being asked, "Where is your beard?" the child would place its hand on its chin and move its thumb and fingers as if drawing hair through them, or as it was in the habit of doing if it touched its father's beard; this is evidence of imagination, which, however, certainly occurs much earlier in life. At the close of the second year a great advance was made in using two words together as a sentence—*e. g.*, "home, milk," to signify a desire to go home and have some milk. In the first month of the third year sentences of three or even four words were used, as "papa, pear, plate, please." Hitherto the same word would often be employed to express several or many associated meanings, and no words appeared to have been entirely invented. The powers of association and inference were well developed. For instance, the child received many presents on its birthday, and being pleased said "bursta" (= Geburtstage); afterward when similarly pleased it would say the same word. Again, when it injured its hand it was told to blow upon it, and on afterward knocking its head it blew into the air. At this age also the power of making propositions advanced considerably, as was shown, for instance, by the following sentence on seeing milk spilt upon the floor: "Mime atta teppa papa oi," which was equivalent to "Milch fort (auf den) Teppich, Papa (sagte) pfui!" But it is interesting that at this age words were learnt with an erroneous apprehension of their meaning; this was particularly the case with pronouns—"dein Bett," for example, being supposed to mean "das grosse Bett." All words which were spontaneously acquired seemed to be instances of onomatopœia. Adverbs were first used in the twenty-seventh month, and now also words which had previously been used to express a variety of associated or generic meanings, were discarded for more specific ones. In the twenty-eighth month prepositions were first used, and questions were first asked. In the twenty-ninth month the chief advance was in naming self with a pronoun, as in "give me bread;" but the word "I" was not yet spoken. When asked: "Wer ist mir?" the child would say its own name. Although the child had long been able to say its numerals, it was only in this month that it attained to an understanding of their use in counting. In the thirty-second month the word "I" was acquired, but still the child seemed to prefer speaking of itself in the third person.

The long disquisition on the acquirement of speech is supplemented by a chapter conveying the observations of other writers upon the same subject. This is followed by an interesting chapter on the development of self-consciousness, and the work concludes with a summary of results. There are also lengthy appendices on the acquirements of correct vision after surgical operations by those who have been born blind, and on the mental condition of uneducated deaf mutes; but we have no space left to go into these subjects. Enough, we trust, has been said to show that Professor Preyer's laborious undertaking is the most important contribution which has yet appeared to the department of psychology with which it is concerned. George J. Romanes.

THE RACIAL CHARACTERISTICS OF MAN.

Dr. Zerffi, F.R.Hist.S., recently delivered the first of the inaugural lectures in connection with the opening of the Crystal Palace Company's School of Art, on "The Racial Characteristics of Man Scientifically Traced in General History." He complained that the study of man from a scientific point of view, especially in history as enacted by him, was mostly neglected, although it ought to be—nay, would and must more and more become—our most important subject, as forming the only real basis of all our higher culture. History was undoubtedly a deductive science, but it could be verified and put to the best uses by the purely inductive study of facts. Any change, whether progressive or retrospective, in the social, political, or religious condition of men, would be a fact. The acting forces were men, of whom there were on the globe more than a thousand millions, all endowed with three principal faculties—of receiving impressions, which produced sensations, and were reflected in their intellectual consciousness. But neither in comparing individuals with one another, nor race with race, were these faculties equally developed. They varied with a race's average facial angles and lines, its amount of brain, the color of its skin, and its general organization. The facial angle of the black races might be taken at 85°, and the number of cubic inches of brain might range between 75 and 80. In an ethnological chart hung behind the lecturer, the main body of the Nigritian races, which was made up of the Asiatic and African negroes, was credited with 88 cubic inches of brain as a general statement. It was remarked, however, that the brain was very small relatively to the body, while the cerebellum formed a very large portion of the organ. The statical and dynamical forces of the intellect were said to be undeveloped, the animal propensities predominating. The long extinct American Toltecs, ranking as one section of a subdivision under this head, figured for 79 cubic inches of brain. In both directions the intellectual forces were marked as undeveloped, but the Toltecs were credited with great imitative powers. The other section, comprising the Hottentots and Australian black fellows, were allowed but 75 cubic inches of brain, or not more than 10 above the highest anthropoid apes, and in neither did the statical or dynamical intellect pass beyond a transitory stage of the lowest degree. The typical facial angle of the yellow or Turanian races—the bulk being Chinese, Mongols, Finns, Turks, with Malay, Gangetic, Lohitic, Tamulic, and American tribes—was given as 87½ degrees. In cubic inches, the brain ranged between 82 and 95. In the chart the figure given was 83½. Here, too, the statical or conservative energy of the intellect was made the great characteristic, the dynamical or progressive developing for the most part in technical products only. The tendency was to become herdsmen, farmers, and traders. As a division were classed the aborigines of India and of Egypt, with an average 80 cubic inches of brain, a very large cerebellum, and a cerebrum comparatively small. Their intellect was as characteristically statical as that of the other yellow races, the dynamic impulse manifesting itself only in symbolism, mysticism, and the like. At the head of all stood the white races, Aryans for the most part, but with the Semites—Chaldeans, Phœniceans, Hebrews, Carthaginians, Arabs—as a subdivision. Ideally, their facial angle was 90°—the right angle—and their cubic inches of brain ranged from 92 to 120, rising in individual instances—the lecturer named Byron—as high as 150. The number in the chart for the Aryans—Sanskrit-speaking Indians, the Greeks and Romans, the Goths, Kelts, Slavs, and their progeny—was 92, and for the Semitic peoples 88. The Aryans were credited with a due balance between the dynamical and statical energy of their intellect, to which they owed nearly all the great inventions and discoveries, and with all the systematic development of science. They brought forth the philosophers, moralists, engineers, sculptors, musicians. The Semitic intellect was predominantly statical, being but little developed in the creative or dynamical direction, and then mostly in theological thought. They produced, however, musicians, traders, and conquerors.

ECCENTRICITY AND IDIOSYNCRASY.*

By William A. Hammond, M.D., Surgeon-General U. S. Army (Retired List), Professor of Diseases of the Mind and Nervous System in the New York Post-Graduate Medical School, etc.

Eccentricity.—Persons whose minds deviate in some one or more notable respects from the ordinary standard, but yet whose mental processes are not directly at variance with that standard, are said to be eccentric. Eccentricity is generally inherent in the individual, or is gradually developed in him from the operation of unrecognized causes as he advances in years. If an original condition, it may be shown from a very early period of life, his plays, even, being different from those of other children of his age. Doubtless it then depends upon some peculiarity of brain structure, which, within the limits of the normal range, produces individuality of mental action.

But eccentricity is not always an original condition, for, under certain circumstances, it may be acquired. A person, for instance, meets with some circumstance in his life which tends to weaken his confidence in human nature. He accordingly shuns mankind, by shutting himself up in his own house and refusing to have any intercourse with the inhabitants of the place in which he resides. In carrying out his purpose he proceeds to the most absurd extremes. He speaks to no one he meets, returns no salutations, and his relations with the tradesmen who supply his daily wants are conducted through gratings in the door of his dwelling. He dies, and the will which he leaves behind him is found to devote his entire property for the founding of a hospital for sick and ownerless dogs, "the most faithful creatures I have ever met, and the only ones in which I have any confidence."

Such a man is not insane. There is a rational motive for his conduct—one which many of us have experienced, and which has, perhaps, prompted us to act in a similar manner, if not to the same extent.

Another is engaged in vast mercantile transactions, requiring the most thorough exercise of the best faculties of the mind. He studies the markets of the world, and buys and sells with uniform shrewdness and success. In all the relations of life he conducts himself with the utmost propriety and consideration for the rights and feelings of others. The most complete study of his character and acts fails to show the existence of the slightest defect in his mental processes. He goes to church regularly every Sunday, but has never been regarded as a particularly religious man. Nevertheless, he has one peculiarity. He is a collector of Bibles, and has several thousand, of all sizes and styles, and in many languages. If he hears of a Bible, in any part of the world, different in any respect from those he owns, he at once endeavors to obtain it, no matter how difficult the undertaking, or how much it may cost. Except in the matter of Bibles he is disposed to be somewhat penurious—although his estate is large —and has been known to refuse to have a salad for his dinner on account of the high price of good olive-oil. He makes his will, and dies, and then it is found that his whole property is left in trust to be employed in the maintenance of his library of Bibles, in purchasing others which may become known to the trustees, and in printing one copy, for his library, of the book in any language in which it does not already exist. A letter which is addressed to his trustees informs them that, when he was a boy, a Bible which he had in the breast-pocket of his coat preserved his life by stopping a bullet which another boy had accidentally discharged from a pistol, and that he then had resolved to make the honoring of the Bible the duty of his whole life.

Neither of these persons can be regarded as insane. Both were the subjects of acquired eccentricity, which, in all likelihood, would have ensued in some other form, from some other circumstance acting upon brains naturally predisposed to be thus affected. The brain is the soil upon which impressions act differently, according to its character, just as, with the sower casting his seed-wheat upon different fields, some springs up into a luxuriant crop, some grows sparsely, and some, again, takes no root, but rots where it falls. Possibly, if these individuals had lived a little longer, they might have passed the border-line which separates mental soundness from mental unsoundness; but certainly, up to the period of their deaths, both would have been pronounced sane by all competent laymen and alienists with whom they might have been brought into contact; and the contest of their wills, by any heirs-at-law, would assuredly have been a fruitless undertaking.

They chose to have certain ends in view, and to provide the means for the accomplishment of those ends. There were no delusions, no emotional disturbance, no hallucinations or illusions, and the will was normally exercised to the extent necessary to secure the objects of their lives. At any time they had it in their power to alter their purposes, and

* An extract from a Treatise on Insanity shortly to be published by D. Appleton & Co.

in that fact we have an essential point of difference between eccentricity and insanity. We may regard their conduct as singular, because they made an unusual disposition of their property; but it was no more irrational than if the one had left his estate to the "Society for the Prevention of Cruelty to Animals," and the other had devoted his to sending missionaries to Central Africa.

Two distinct forms of eccentricity are recognizable. In the one, the individual sets himself up above the level of the rest of the world, and, marking out for himself a line of conduct, adheres to it with an astonishing degree of tenacity. For him the opinions of mankind in general are of no consequence. He is a law unto himself; what he says and does is said and done, not for the purpose of attracting attention or for obtaining notoriety, but because it is pleasing to himself. He does not mean to be singular or original, but he is, nevertheless, both. For every man is singular and original whose conduct, within the limits of reason and intelligence, differs from that of his fellow-men. He endeavors to carry out certain ideas which seem to him to have been overlooked by society to its great disadvantage. Society usually thinks different; but if the promulgator is endowed with sufficient force of character, it generally happens that, eventually, either wholly or in part, his views prevail. All great reformers are eccentrics of this kind. They are contending for their doctrines, not for themselves. And they are not apt to become insane, though sometimes they do.

The subjects of the other form occupy a lower level. They affect singularity for the purpose of attracting attention to themselves, and thus obtaining the notoriety which they crave with every breath they inhale. They dress differently from other people, wearing enormous shirt-collars, or peculiar hats, or oddly cut coats of unusual colors, or indulging in some other similar whimsicality of an unimportant character, in the expectation that they will thereby attract the attention or excite the comments of those they meet.

Or they build houses upon an idea perhaps correct enough in itself, as, for instance, the securing of proper ventilation; but in carrying it out they show such defective judgment that the complete integrity of the intellect may, perhaps, be a matter of question. Thus, one gentleman of my acquaintance, believing that fireplaces were the best ventilators, put four of these openings into every room in his house. This, however, was one of the smallest of his eccentricities. He wore a ventilated hat, his clothing was pierced with holes, as were even his shoes; and no one could be in his company five minutes without having his attention directed to these provisions for securing health.

In addition to these advanced notions on the subject of ventilation, he had others equally singular in regard to the arrangement of the furniture in his dwelling and the care that was to be taken of it. Thus, there was one room called the "apostles' room." It contained a table that represented Christ, and twelve chairs, which were placed around it, and typified the twelve apostles; one chair, that stood for Judas Iscariot, was covered with black crape. The floor of this room was very highly polished, and no one was allowed to enter it without slipping his shod feet into cloth slippers that were placed at the door ready for use. He had a library, tolerably large but of little value, and every book in it which contained Judas's name was bound in black, and black lines were drawn around the name wherever it occurred. Such eccentricity as this is not far removed from insanity, and is liable at any time, from some cause a little out of the common way, to pass over the line.

Thus, a lady had since her childhood shown a singularity of conduct as regarded her table furniture, which she would have of no other material than copper. She carried this fancy to such an extent that even the knives and forks were of copper. People laughed at her, and tried to reason her out of her whim, but in vain. She was in her element as soon as attention was directed to her fancy and arguments against it were addressed to her. She liked nothing better than to be afforded a full opportunity to discuss with any one the manifold advantages which copper possessed as a material to be used in the manufacture of every article of table ware. In no other respect was there any evidence of mental aberration She was intelligent, by no means excitable, and in the enjoyment of excellent health. She had, moreover, a decided talent for music, and had written several passably good stories for a young ladies' magazine. An uncle had, however, died insane.

A circumstance, trifling in itself, but one, as it afterward resulted, of great importance to her, started in her a new train of thought, and excited emotions which she could not control. She read in a morning paper that a Mr. Koppermann had arrived at one of the hotels, and she announced her determination to call upon him, in order, as she said, to ascertain the origin of his name. Her friends endeavored to dissuade her, but without avail. She went to the hotel, and was told that he had just left for Chicago. Without returning to her home, she bought a railway ticket for Chicago, and actually started on the next train for that city. The telegraph, however, overtook her, and she was brought back from Rochester raving of her love for a man she had never seen, and whose name alone had been associated in her mind with her fancy for copper table furniture. She died of acute mania within a month. In this case erotic tendencies, which had never been observed in her before, seemed to have been excited by some very indirect and complicated mental process, and these in their turn developed into general derangement of the mind.

In another case, a young man, a clerk in a city bank, had for several years exhibited peculiarities in the keeping of his books. He was exceedingly exact in his accounts, but after the bank was closed always remained several hours, during which he ornamented each page of his day's work with arabesques in different-colored inks. He was very vain of this accomplishment, and was constantly in the habit of calling attention to the manner in which, as he supposed, he had beautified what would otherwise have been positively ugly. His fellow-clerks amused themselves at his expense, but his superior officers, knowing his value, never interfered with him in his amusement. Gradually, however, he conceived the idea that they were displeased with him, and at last the notion became so firmly rooted in his mind that he resigned his position, notwithstanding the protestations of the directors that his idea was erroneous. Delusions of various other kinds supervened, and he passed into a condition of chronic insanity, in which he still remains. In most of the cases occurring under this head the intellectual powers are not of a high order, though there may sometimes be a notable development of some talent, or even a great power for acquiring learning. Painters, sculptors, musicians, mathematicians, poets, and men of letters generally, not infrequently exhibit eccentricities of dress, conduct, manner, or ideas, which not only merely add to their notoriety, but often make them either the laughing-stocks of their fellow-men or objects of fear or disgust to all who are brought into contact with them.

IDIOSYNCRASY.—By idiosyncrasy we understand a peculiarity of constitution by which an individual is affected by external agents in a manner different from mankind in general. Thus, some persons cannot eat strawberries without a kind of urticaria appearing over the body; others are similarly affected by eating the striped bass; others, again, faint at the odor of certain flowers, or at the sight of blood; and some are attacked with cholera-morbus after eating shell-fish—as crabs, lobsters, clams, or mussels. Many other instances might be advanced, some of them of a very curious character. These several conditions are called idiosyncrasies.

Bégin,* who defines idiosyncrasy as the predominance of an organ, a viscus, or a system of organs, has hardly, I think, fairly grasped the subject, though his definition has influenced many French writers on the question. It is something more than this—something inherent in the organization of the individual, of which we only see the manifestation when the proper cause is set in action. We cannot attempt to explain why one person should be severely mercurialized by one grain of blue mass, and another take daily ten times that quantity for a week without the least sign of the peculiar action of mercury being produced. We only know that such is the fact; and were we to search for the reason, with all the appliances which modern science could bring to our aid, we should be entirely unsuccessful. According to Bégin's idea, we should expect to see some remarkable development of the absorbent system in the one case, with slight development in the other; but, even were such the case, it would not explain the phenomena, for, when ten grains of the preparation in question are taken daily, scarcely a day elapses before mercury can be detected in the secretions, and yet hydrargyriasis is not produced; while when one grain is taken, and this condition follows, the most delicate chemical examination fails to discover mercury in any of the fluids or tissues of the body.

Bégin's definition scarcely separates idiosyncrasy from temperament, whereas, according to what would appear to be sound reasoning, based upon an enlarged idea of the physiology of the subject, a very material difference exists.

Idiosyncrasies are often hereditary and often acquired. Two or more may exist in one person. Thus, there may be an idiosyncrasy connected with the digestive system, another with the circulatory system, another with the nervous system, and so on.

An idiosyncrasy may be of such a character as altogether to prevent an individual following a particular occupation. Thus, a person who faints at the sight of blood cannot be a surgeon; another, who is seized with nausea and vomiting when in the presence of insane persons, cannot be a superintendent of a lunatic asylum—not, at least, if he ever expects to see his patients. Idiosyncrasies may, however, be overcome, especially those of a mental character.

Millingen† cites the case of a man who fell into convulsions whenever he saw a spider. A waxen one was made, which equally terrified him. When he recovered, his error was pointed out to him. The wax figure was put into his hand without causing dread, and shortly the living insect no longer disturbed him.

I knew a gentleman who could not eat soft crabs without experiencing an attack of diarrhea. As he was exceedingly fond of them, he persevered in eating them, and finally, after a long struggle, succeeded in conquering the trouble.

Individuals with idiosyncrasies soon find out their peculiarities, and are enabled to guard against any injurious result to which they would be subjected but for the teachings of experience.

Idiosyncrasies may be temporary only—that is, due to an existing condition of the organism, which, whether natural or morbid, is of a transitory character. Such, for instance, are those due to dentition, the commencement or the cessation of the menstrual function, pregnancy, etc. These are frequently of a serious character, and require careful watching, especially as they may lead to derangement of the mind. Thus, a lady, Mrs. X, was at one time under my professional care, who, at the beginning of her first pregnancy, acquired an overpowering aversion to a half-breed Indian woman who was employed in the house as a servant. Whenever this woman came near her she was at once seized with violent trembling, which ended in a few minutes with vomiting and great mental and physical prostration, lasting several hours. Her husband would have sent the woman away, but Mrs. X insisted on her remaining, as she was a good servant, in order that she might overcome what she regarded as an unreasonable prejudice. The effort was, however, too much for her, for upon one occasion when the woman entered Mrs. X's apartment rather unexpectedly, the latter became greatly excited, and, jumping from an open window in her fright, broke her arm, and otherwise injured herself so severely that she was for several weeks confined to her bed. During this period, and for some time afterward, she was almost constantly subject to hallucinations, in which the Indian woman played a prominent part. Even after her recovery the mere thought of the woman would sometimes bring on a paroxysm of trembling, and it was not till after her confinement that the antipathy disappeared.

Millingen‡ remarks that certain antipathies, which in reality are idiosyncrasies, appear to depend upon peculiarities of the senses. Rather, however, they are due to peculiarities of the ideational and emotional centers. The organ of sense, in any one case, shows no evidence of disorder; neither does the perceptive ganglion, which simply takes cognizance of the image brought to it. It is higher up that the idiosyncrasy has its seat. In this way we are to explain the following cases collected by Millingen:

"Amatus Lusitanus relates the case of a monk who fainted when he beheld a rose, and never quitted his cell when that flower was blooming. Scaliger mentions one of his relatives who experienced a similar horror when seeing a lily. Zimmermann tells us of a lady who could not endure the feeling of silk and satin, and shuddered when touching the velvety skin of a peach. Boyle records the case of a man who felt a natural abhorrence to honey; without his knowledge some honey was introduced in a plaster applied to his foot, and the accidents that resulted compelled his attendants to withdraw it. A young man was known to faint whenever he heard the servant sweeping. Hippocrates mentions one Nicanor, who swooned whenever he heard a flute; even Shakespeare has alluded to the effects of the bagpipes. Julia, daughter of Frederick, King of Naples, could not taste meat without serious accidents. Boyle fainted when he heard the splashing of water; Scaliger turned pale at the sight of water-cresses; Erasmus experienced febrile symptoms when smelling fish; the Duke d'Epernon swooned on beholding a leveret, although a hare did not produce the same effect; Tycho Brahe fainted at the sight of a fox; Henry III. of France at that of a cat; and Marshal d'Albret at a pig. The horror that whole families entertain of cheese is generally known."

He also cites the case of a clergyman who fainted whenever a certain verse in Jeremiah was read, and of another who experienced an alarming vertigo and dizziness whenever a great height or dizzy precipice was described. In such instances the power of association of ideas is probably the most influential agent in bringing about the climax. There is an obvious relation between the warnings given by the prophet in the one case, and the well-known sensation produced by looking down from a great height in the other, and the effects which followed.

Our dislikes to certain individuals are often of the nature of idiosyncrasies, which we can not explain. Martial says:

> "Non amo te, Sabidi, nec possum dicere quare;
> Hoc tantum possum dicere, non amo te;"

or, in our English version:

> "I do not like you, Doctor Fell,
> The reason why I can not tell;
> But this I know, and that full well—
> I do not like you, Doctor Fell."

Some conditions often called idiosyncrasies appear to be, and doubtless are, due to disordered intellect. But they should not be confounded with those which are inherent in the individual and real in character. Thus, they are frequently merely imaginary, there being no foundation for them except in the perverted mind of the subject; at other times they are induced by a morbid attention being directed continually to some one or more organs or functions. The protean forms under which hypochondria appears, and the still more varied manifestations of hysteria, are rather due to the reaction ensuing between mental disorder on the one part, and functional disorder on the other, than to that quasi normal peculiarity of organization recognized as idiosyncrasy.

Thus, upon one occasion I was consulted in the case of a lady who it was said had an idiosyncrasy that prevented her drinking water. Every time she took the smallest quantity of this liquid into her stomach it was at once rejected, with many evident signs of nausea and pain. The patient was strongly hysterical, and I soon made up my mind that either the case was one of simple hysterical vomiting, or that the alleged inability was assumed. The latter turned out to be the truth. I found that she drank in private all the water she wanted, and that what she drank publicly she threw up by tickling the fauces with her finger-nail when no one was looking.

The idiosyncrasies of individuals are not matters for ridicule, however absurd they may appear to be. On the contrary, they deserve and should receive, the careful consideration of the physician, for much is to be learned from them, both in preventing and in treating diseases. In psychiatrical medicine they are especially to be inquired for. It is not safe to disregard them, as they may influence materially the character of mental derangement, and may be brought in as efficient agents in the treatment.—*N. Y. Medical Journal.*

PYORRHEA ALVEOLARIS.*

By Dr. J. M. RIGGS, of Hartford, Conn.

A GENTLEMAN, a physician, aged thirty-two years, strong and vigorous, with no lack of nerve-energy, calls to have his teeth attended to, with the disease in the first stage throughout the mouth. Upon examination, he observes upon the gum of one of the lower cuspids a dark purplish ring encircling the neck, from one-sixty-fourth to one sixteenth of an inch in depth; the tooth *in situ* is white and clean. With the aid of the mouth and hand mirror he shows the condition to the patient, and, taking up an excavator, endeavors to pass it down between the tooth and gum, on the labial surface. After it gets down a little way the instrument meets with an obstruction, over which, calling the patient's attention to the fact, he carefully guides the instrument until it drops down on the tooth-substance beyond it; then, turning the instrument and pressing it upward, he breaks off a portion of the concretion; which proves to be what is ordinarily called lime-salts, or tartar. That is the cause of the purple ring on the gum, which is merely the outward manifestation of the disease. Take it off thoroughly, polish the surface of the tooth, and in three days' time the gum will show a perfectly healthy color. The condition described is the first stage of the disease, and the treatment given is all that is required for a cure of the case at this time. But take the same man and let him go for ten years without the simple operation detailed. The disease spreads, and causes inflammation of the process, and, finally, its absorption—sometimes on the labial surface for one half or two-thirds the length of the tooth. It runs its course, the tartar accumulating, all the time following up the line of attack. At the end of ten years what has become of the line of tartar? Sometimes it will be found extending clear around the tooth. Sometimes it will not be found at all; it has done its work—the tooth is loose, but the concretion is gone, in whole or in part. In this case the patient wants the tooth out, but, he asks, what has become of the tartar? The answer is that the natural acids found in the oral cavity have dissolved it, and it has passed into the stomach or out of the mouth in the saliva. But the tooth is so loose that it is a torment to the man; it lies in its socket, entirely loose, almost ready to drop over. It hurts so that he cannot bear the pain. The tooth is taken out. There is no tartar on it, or very little; there is a little speck near the point that looks like a foreign body; but the point of the tooth—the apex—is as sharp as a needle. After the disease has done its work of separating the tooth from its socket, the destroying agent begins to absorb the tooth at the point, irregularly, causing the sharpness described. Now, because no tartar is found upon the tooth, does that argue that it has never been there? Not at all; the loosened tooth shows simply that it has been there and has been absorbed. The speaker has never seen a tooth in that condition on the point of which he could not show patches or specks; we may not see the tartar, but it certainly once existed there, and has accomplished its work.

Now suppose we find a patient with all the teeth loosened; he has neuralgia pains in the face, for which medicine seems to furnish no remedy: he has also catarrh, and the malar and nasal bones are all affected. In the third and fourth stages a low inflammatory action pervades all the bones of the face, accompanied by neuralgic pains, extending to the brain itself. In such a case the disease of the teeth intensifies the catarrh. A medical man called upon him for treatment for pyorrhea alveolaris; the patient was also afflicted with ca-

* "Physiologie Pathologique," Paris, 1828, t. i., p. 44.
† "Curiosities of Medical Experience," London, 1837, vol. ii., p. 246.
‡ *Op cit.*, p. 246.

* Abstract from a paper lately read before the Southern Dental Association, Baltimore, Md.

tarrh. He cured the pyorrhea alveolaris, and cured the catarrh, too, at the same time.

Another case.—A lady called in great distress. Nearly all her teeth were affected, and the discharge was most offensive and abundant; if she lay on her side in bed, the pillow would be covered with large splotches of the discharge in the morning; if she lay on her back, the mass was swallowed, and the result was that the whole alimentary canal was demoralized by the pus, blood, and vitiated secretions. When she arose she wanted no breakfast, only two or three cups of strong coffee and some crackers. She was nearly blind, could only see a great light, and was totally unable to see to read. He told her that the trouble with her sight was caused by the diseased condition of the teeth; that unless that was remedied, she might live three months, but she would die suddenly. He treated three or four teeth at a time at each sitting. This consumed three weeks. The teeth became firm, her appetite returned, her sight was restored, and she was able to walk a mile or two without disturbance. He was called to Brooklyn, where they had a live society, and an infirmary for the treatment of dental diseases, at which members of the society were delegated to attend from day to day. He was invited to give a clinic upon pyorrhea alveolaris, and he told them of this patient, whom he showed to some fifteen members. The woman was apparently in fair health. It was not loss of nerve-energy which started the disease in this case, but the disease caused the loss of appetite and the vitiated condition of the whole alimentary canal. Her physician would have sent this woman to the grave, not recognizing the disease and its management.

He maintains that it is not lack of nervous energy that causes this disease, but the disease will lead to loss of nerve-energy. That small purple ring on the gum of the cuspid in the case first mentioned would eventually have led to the loss of the whole set, if left to work its way unopposed. He had tried in these remarks to controvert the old ideas, and to present the cause of the disease and its treatment as he sees it. You may see it differently; if so, give us your information, in order that we may correct our views, if wrong.

One gentleman says he finds it is only those who are strong and vigorous who have this disease. The speaker finds some cases of this kind; he also finds consumptives who have not a trace of it, but he would take the strongest man in the room and cause a beautiful case of pyorrhea alveolaris in his mouth in three weeks, with a fine cotton thread tied around one of the lower front teeth at the line of the gum. The thread will work its way under the gum, and the gum will become inflamed; it will work its way down between the gum and the tooth, and in the meantime the flour and fine particles of food will also work down under the loose gum, finding a rallying-point on the thread; the mass will become impregnated with lime-salts, and will then begin to harden, and in a very short time you will have an excellent example of the disease under discussion. Patients suffering from salivation fall an easy prey to this disease, due to the action of the drug on the glands and the hard and soft tissues of the mouth, the gums in such cases affording a ready pocket under their edges for the deposits.

When you find a tooth with the characteristic concretion of tartar upon it, the first principle of surgery demands that you clean that tooth thoroughly. Go down beyond the line of the disease, go around the tooth thoroughly, and break up the diseased tissue, and apply tincture of myrrh, and in three days you will notice a marked improvement for the better, and if the patient takes proper care of the teeth the disease will not return. Practitioners should watch the teeth of the young people under their care, and see that the mouth is kept scrupulously clean and healthy.

In reply to a question, Dr. Riggs stated that whenever absorption goes on irregularly, unless the inflammatory action is extreme, it will sometimes absorb one or two bone-cells, and then skip one or two, and these last, being isolated, naturally die, or become necrosed to some extent. In treating this disease you must break up the line of disintegrated tissue. You must, as it were, transfer your eyesight to the end of the instrument, so that when you strike dead bone you will know it. Live bone will feel smooth and greasy.

It requires some years of experience to treat this disease properly, because you have not your eyesight to aid you, but must depend absolutely upon the sense of touch. With experience, however, you will learn to give a great deal of relief in one of the most annoying conditions to which the teeth are subject. The reason the profession are not familiar with the treatment of this disease is, they fail to recognize it until it reaches its third or fourth stage, and then they treat it by depletion and therapeutic remedies. Some treat it by stippling in acids underneath the gum, thinking thereby to dissolve away not only the tartar, but the necrosed bone. Another writer takes off patches of the diseased tissue, and another a strip of the gum, from wisdom-tooth to wisdom-tooth. This treatment he could only characterize as simply barbarous. The treatment of this disease is purely surgical. Any therapeutic treatment is to alleviate the pain and soreness immediately after the operation.

Dr. W. N. Morrison, St. Louis, referring to the method of treating pyorrhea alveolaris described by Dr. Riggs, said he cheerfully bore testimony to the importance of loosening the scales of tartar, and teaching patients the value of cleanliness of the mouth. In his experience he had found that all instruments will occasionally fail to dislodge the deposit. In such cases he used as an assistant a little ring of para gum about an eighth of an inch wide. This was sprung on the tooth at the edge of the gum. If this is done and the ring is allowed to remain a few hours, you will see an entirely new revelation, and you will readily be able to get at the tooth to clean it. He had found it advisable to give patients a practical showing how the brush should be used.

SULPHUR AS A PRESERVATIVE AGAINST MARSH FEVER.

AT a recent meeting of the Paris Academy, M. D'Abbadie called attention to some facts regarding marsh fever, which African travelers and others might do well to ponder. Some elephant hunters from plateaus with comparatively cool climate brave the hottest and most deleterious Ethiopian regions with impunity, which they attribute to their habit of daily fumigation of the naked body with sulphur. It was interesting to know whether sulphurous emanations, received involuntarily, have a like effect. From inquiries made by M. Fouqué, it appears that in Sicily, while most of the sulphur mines are in high districts and free from malaria, a few are at a low level, where intermittent fever prevails. In the latter districts, while the population of the neighboring villages is attacked by fever in the proportion of 90 per cent., the workmen in the sulphur mines suffer much less, not more than eight or nine per cent. being attacked. Again, on a certain marshy plain near the roadstead in the island of Milo (Grecian Archipelago), it is hardly possible to spend a night without being attacked by intermittent fever, yet on the very fertile part near the mountains are the ruins of a large and prosperous town, Zephyria, which, 300 years ago, numbered about 40,000 inhabitants. Owing to the ravages of marsh fever the place is now nearly deserted. One naturally asks how such a town grew to its former populous state. Sulphur mining has been an important source of wealth in Milo from the time of the ancient Greeks. Up to the end of last century the sulphur was chiefly extracted at Kalamo, but since that time it has only been mined on the east coast of the island. The decadence of Zephyria has nearly corresponded to this transference. The sulphurous emanations no longer reach the place, their passage being blocked by the mountain mass. Once more, on the west side of the marshy and fever-infested plain of Catania, traversed by the Simeto, is a sulphur mine, and beyond it, at a higher level, a village which was abandoned in the early part of this century because of marsh fever. Yet there is a colony of workmen living about the mine, and they seem to be advantageously affected by the emanations. M. D'Abbadie further mentions that the engineer who made a railway through this notorious plain preserved the health of his workmen by requiring them to drink no water but what was known to be wholesome and was brought from a distance.

HYDRAULIC FILTERING PRESS FOR TREATING OLEAGINOUS SEEDS.

MESSRS. LAURENT BROS. & COLLOT exhibited at the Paris Universal Exhibition in 1878 a patented hydraulic apparatus styled a filtering press, the principle and construction of which it will prove of interest to describe. The apparatus is remarkable for its simplicity and ease of manipulation, and is destined to find an application in most oil mills.

Details of Structure.—The filter, which is shown in detail in Figs. 5 to 7, is formed of two semicylindrical cast iron shells, F, that are firmly united, and held by a strong iron band which is cleft at one point in its circumference, and to which there is adapted a mechanism permitting of loosening it slightly so as to facilitate the escape of the oil-cake. Within these shells, F, there are grooves, *a*, which have the arrangement shown by the partial section in Fig. 11, and through which flows the oil expressed by pressure. To prevent the escape of the material through these grooves or channels, the interior of the shells is lined throughout with plates or strips of brass that fit very closely together, and present a simple slit with chamfered edges opposite the grooves. At the two joints of the shells four of these plates are riveted two by two; all the others are movable, and rest, like the pieces of an arch, against the fixed plates that form abutments. Each half lining is thus held by means of a central plate, *b'* (Fig. 10), with oblique edges, and which, being driven home by the top of the filter, binds the whole tightly together. All these plates, which are slightly notched at their upper part, rest on a small flange at the lower part of the shells.

As regards their manufacture, these plates are cut out of sheets of perfectly laminated brass, and are afterward set into a matrix to center them properly. After the shells have been bored out, all the plates are mounted therein so as to obtain a perfectly cylindrical and uniform surface. The plates are then numbered and taken out; and, finally, a slit with chamfered edges is cut longitudinally through them, save at three points—two at the extremities and one at the middle. The plates thereafter rest against each other only at these three points, and leave at the chamfered places capillary openings just sufficient to give passage to the oil, but not to the pressed paste, however fine it be. As will be seen in Fig. 5, the points of contact are not in the same horizontal plane, but are arranged spirally, so that the flow will not be stopped at this place as it would be were these solid parts all at the same height. The filter, F, is completed by two pieces that play an important part. The first of these is a cast iron rim, J, which is set into the upper edge, and forms a sort of lip whose internal diameter corresponds exactly to the surface of the plates, *b*. This rim, J, is cast in one piece, and carries on its circumference two small, diametrically opposite iron studs, which are so placed that they may engage in the groove, *p*, at the upper edge of the shells, F.

The second of the two pieces is a cast iron bottom, K, which works on a hinge-joint, and which is perforated with a large number of holes for giving passage to the oil that has traversed the hair cloth cushion of which we shall speak further on. These holes must correspond accurately with the radial conduits presented by plate, E, and through which flows the oil to a circular channel running around this same piece. In order to exactly maintain such a relation between the holes and channels, the piece, E, is provided with a stirrup-iron, *d*, that passes around one of the columns, C, of the hydraulic press.

The entire filter thus constructed is attached to one of the columns, C', of the hydraulic press in such a way that it can revolve around it. For this purpose, the column is surrounded by an iron sleeve, L, cast in two pieces, and which in its lower position rests on the shoulder, *e*, of the column. The filter is connected with the sleeve by means of screws, as shown in Fig. 6.

We shall now describe the mechanism for loosening the band, I, and moving the bottom, K.

The band, I (Figs. 5 to 9), is cleft at a point in its circumference corresponding to one of the joints of the shell, F, and carries at each side of the cleft a bearing in which turns freely a steel pin. One of these latter, *i*, is cylindrical, and the other, *j*, has eccentric extremities that are connected with the former by two small iron rods, *k* and *l*. The upper extremity of the pin, *j*, is provided with a bent lever-handle, M, and the lower one carries in its turn a small disk, *m*, the use of which will be explained further on. It results from such an arrangement that by acting on the lever, M, with the band, and by reason of the eccentricity of the pin, *j*, the two extremities of the band, I, may be made to approach or recede at the will of the operator. The position of nearest approximation is limited by the abutting of the hook at the end of the lever, M, against the side of the filter. This latter position corresponds to the moment of charging the apparatus (Fig. 6), while the contrary one indicates the moment that the oil cake falls (Fig. 4). Although the separation is but a few millimeters, it is sufficient for disengaging and allowing the cake to drop.

The movable bottom, K (Figs. 5 and 6), which closes the base of the filter during the pressing, becomes detached and drops vertically (Figs. 3 and 4), when the filter is disengaged from the press, and the oil cake is to be dropped out. To render the maneuver of this part easy, the bottom is provided with a projecting piece, N, united by a bolt with the band, I, and furnished with an articulated hand-lever, N', that terminates in an appendage, *q*. The upper part of the hinge is provided with a tail piece, *q'*, under which the appendage *q*, places itself when the bottom, K, is brought to its horizontal position. Consequently, when the operator desires to let the bottom drop in the position shown by the dotted line (Fig. 5), after the filter has been loosened, he moves the lever, N, to the position shown by the dotted line (Fig. 6). The appendage, *q*, then disengages itself from the tail piece, *q'*, and the bottom is thus enabled to assume a vertical position. As the bottom at the time of charging would not be sufficiently supported if there merely existed the lever and catch, it is further provided at its opposite extremity with an appendage, *r*, which slides over a catch, *r'*. This latter is attached to the disk, *m*, at the lower extremity of the pin, *j* (Fig. 7), and takes exactly the proper position when the band is closed at the moment of charging, but leaves it, on the contrary, when the band is loosened to allow the oil cake to drop out.

As the lateral flow takes place through the interstices of the brass lining, there is need of but one cushion on the bottom and another at the top to hold the material to be pressed. The first is a simple hair-cloth disk for preventing the seed from passing through the perforations in the bottom plate; and the second, O, of which Figs. 12 and 13 represent a segment, is formed of three thicknesses of the same material united at the edges by two flat iron circles, *s*, riveted together. These circles, which are made to fit the inside diameter of the shells very accurately, prevent any leakage of the oil around the presser, G, and keep the hairs from getting caught between this piece and the plates, *b*.

Charging of the Filter. (Figs. 14 and 15.)—The apparatus for charging the filter is of the same capacity as the latter, and is made of galvanized iron. It is placed on a slide at the aperture of the steam-kettle so as to receive the warm seed as it is thrown out by the stirrer. When full, it is taken up by its handles, rested on the rim of the filter, and its contents emptied therein.

General Manipulation of the Press.—Supposing the filter in the position shown in Figs. 3 and 4, at the moment the seedcake is about to drop out: the operator takes hold of the lock lever, N, with his left hand, raises the bottom, K, to a horizontal position, and at the same time fastens the bolt of the lever by turning it. He then seizes the lever, M, with his right hand, and turns it so as to close the filter, having care at the same time to support the extremity, *r*, of the bottom with his left hand so that the catch, *r'*, may pass under it when the lever is manipulated. The bottom hair-cloth is then put in place, the charge is thrown in, and its surface leveled, and the hair-cloth cushion is laid on top. The filter is then revolved around the column so as to bring it into the position shown in Fig. 1. The cock of the distributer that admits water under pressure being turned on, the ram, D, rises, carries with it the filter, and compresses the material against the presser, G. At the end of from six to ten minutes the pressure-valve is closed and the discharge-valve opened. The filter then slides down with its socket along the column, C', till it reaches the shoulder, *e*, where it rests. It is next swung around to the position shown in Fig. 3, and emptied of its contents by a manipulation, the reverse of that described for charging it. All these manipulations of charging and emptying require no more than half a minute on the part of an experienced workman.

The press under consideration is well adapted to the treatment of heated seed paste, and has been very successfully employed for that purpose in France, Belgium, and Holland. It succeeds equally well for the extraction of oil from nuts. Referring to the drawings, the scales are for Figures 1, 2, 3, 4, 14, 15, one-fifteenth actual size; Figures 5, 6, 7, 8, 9, one-tenth; Figures 10, 11, 12, and 13, one-fifth.—*Machines, Outils et Appareils.*

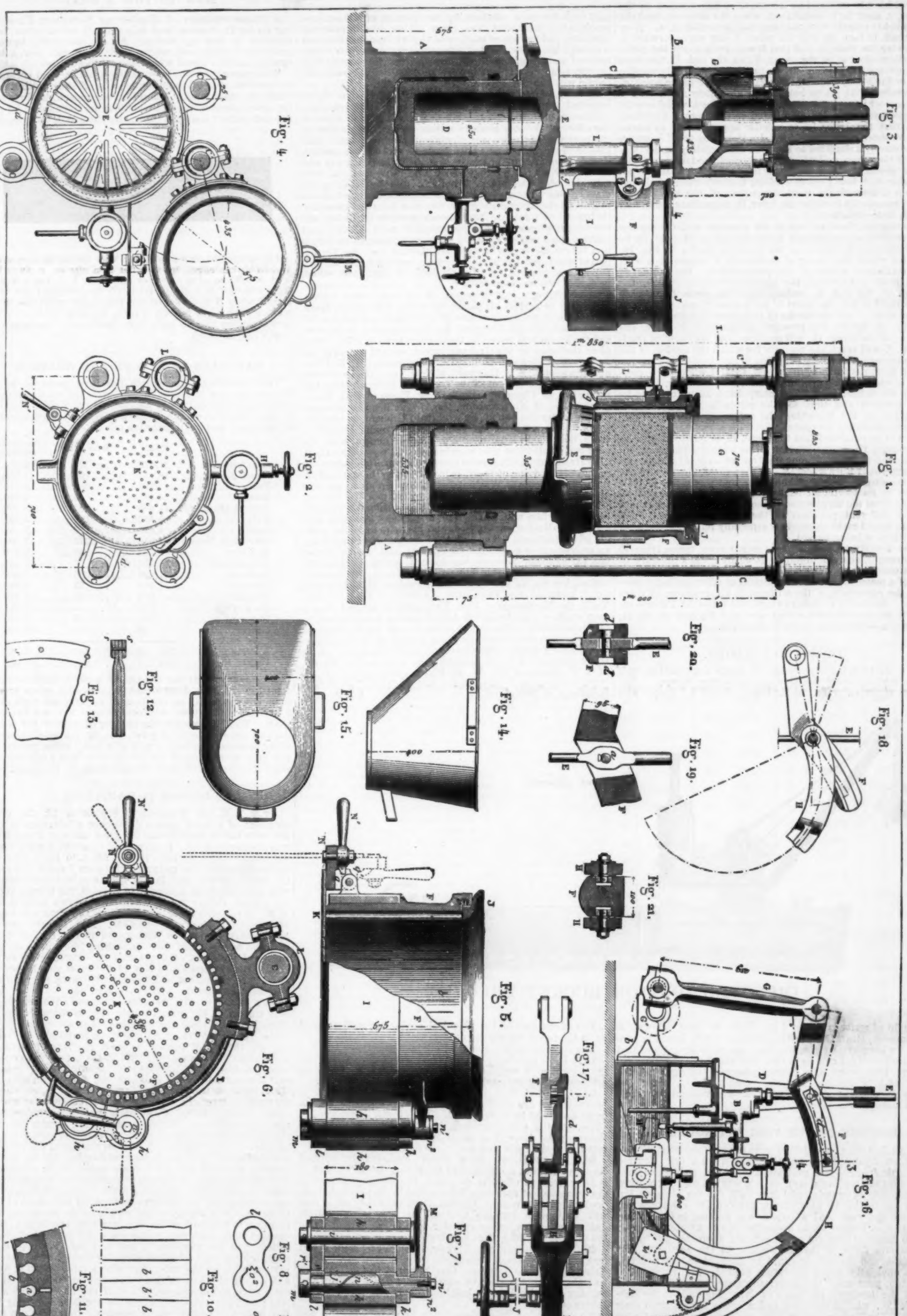
LAURENT & COLLOT'S AUTOMATIC INJECTION PUMP.

As well known, in every well-constructed injection pump, there is a system of gearing which acts upon the suction valve and stops the operation of the pump as soon as the requisite pressure is reached; but the piston, for all that, continues its motion, and, besides, the resistant work of the pump has passed through different degrees of intensity, seeing that at every moment of its operation the piston has preserved the same stroke and velocity. We are speaking, be it understood, of pumps that are controlled mechanically. In the one that we are about to describe, things take place far otherwise. In measure as the pressure increases, the stroke of the piston diminishes, and when it has reached its maximum, the motion of the piston ceases entirely. If, during the operation progression undergoes more or less variation, that is, for example, if it diminishes at a given moment to afterwards increase, the stroke of the piston undergoes all the influences of it.

The pump of which we speak is shown in Figs. 16 to 21, and is the invention of Messrs. Laurent Bros. & Collot. It may be described briefly as follows:

The apparatus, as a whole, has for base a cast-iron reservoir, A, to the top of which is fixed the pump properly so-called, B, as well as the clack box, A, and safety valve. The pump is placed opposite an upright, D, whose top serves as a guide to the prolongation, E, of the piston rod. This latter is traversed by a pivot, *a* (Fig 19), on which is mounted a lever, F, whose outer extremity is articulated with a connecting rod, G, which is itself connected with the cranked shaft, G'. This shaft has for its bearings two supports, *b*, attached to the reservoir, and carries the driving pulleys and a fly wheel. The beam, F, having to give motion to the piston in describing an arc of a circle at the extremity attached to the connecting rod, must, for that reason, have a fixed point of oscillation, or one that we must consider as such for the instant. Now, such point is selected on a piece, H, having the shape of the letter C, and which plays an important part in the working of the pump. This piece is really a two-armed lever, having its center of oscillation in two brackets, *c*, at the base of the reservoir. Fig. 17 shows the relation of the beam, F, and lever, H. The upper extremity of this latter is forked, and embraces the beam, F, whose external surfaces are provided with two slots, *d*, in which move slides, *e*, attached to studs, *f*, which are perfectly stationary on the extremities of the forks of the lever, H. One of the slots is shown in section on the line 1—2 in Fig. 20, and on the line 3—4 in Fig. 21.

Things thus arranged, if we suppose the piece, H, absolutely stationary, it is clear that, as the oscillation of the beam, F, is effected on the studs, *f*, as centers, the piston of the pump will perform an invariable travel whose extent will be dependent upon its position between such point of oscillation and the point of articulation of the connecting rod, G. But we must observe that even according to such a hypothesis, the point, *f*, would not be entirely stationary, because the point of articulation, *a*, upon the piston rod



FILTERING PRESS FOR OLEAGINOUS SEEDS.—AUTOMATIC INJECTION PUMP.

being obliged to follow an invariably straight line, the slots, *d*, will have to undergo an alternate sliding motion on the slides, *e*, save, be it understood, when the latter are brought to coincide exactly with the center of articulation, *a*. Now we shall, in fact, see that the point, *f*, can move forward in following the slots, *d*, and that it may even reach the point of articulation, *a*, of the beam, F, on the rod, E, that is to say, occupy the position shown in Fig. 18, where the oscillation of the beam, F, being effected according to the point, *a*, the stroke of the piston has become absolutely null.

The position of the piece, H, is, in effect, variable with the pressures that are manifested in the pump. It will be seen that the latter has a tubular appendage, *g*, in whose interior there plays what is called a "starting rod," *h*, which is constantly submitted to the pressures existing in the interior of the pump, and which rests against the lower arm, H[1], of the piece, H. But this latter is also loaded at the opposite side with heavy counterpoises, *i*, which counterbalance, within a determinate limit, the action of the rod, *h*, that tends constantly to cause the lever, H, to oscillate around its pivot, in the brackets, *c*.

To sum up, then, as long as the pressure in the pump has not reached a determinate limit, the lever, H, held by its counterpoises, *i*, will keep the position shown in Fig. 16, and for which the center of oscillation, *f*, corresponds with the maximum stroke of the pump piston. But as soon as such limit is exceeded, the equilibrium being broken, the action of the rod, *h*, predominates, the piece, H, reverses from right to left, the point of oscillation, *f*, moves forward in the slots, *d*, and the stroke of the piston is reduced just so much. If, finally, the pressure continues to increase, the motion of the piece, H, will continue, and the point of oscillation, *f*, will reach the position for which the motion of the piston ceases completely (Fig. 18).

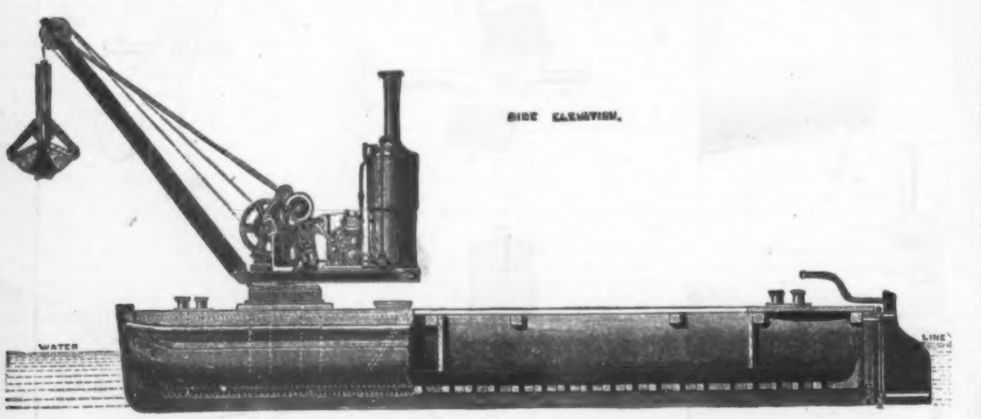
But it results further, therefrom, that if when such position is reached, the pressure diminishes, the lever, H, will, under the influence of its counterpoise, tend to return to its first position and thus set the piston in motion. As we remarked in the beginning, the automatism of these functions is absolutely complete.

It will be remarked that the piece, H, is provided with an appendage, H[2], whose interior forms a rack. This rack engages with a pinion, I, mounted on an axle, J, which carries externally a fly wheel, K. This axle, J, moves with the various displacements of the lever, and its fly wheel overcomes by its inertia all backward and forward shocks resulting from the thrusts due to the sliding of the steel slides in the different positions of the connecting rods. Such shocks would make themselves especially felt while the dead centers were being passed.

The velocity with which this pump runs varies from 75 to 80 revolutions per minute. It easily gives a pressure of 200 atmospheres. With a hydraulic press having a piston 0·27of a meter in diameter, it permits of effecting in ten minutes the extraction of the oil from 25 kilogrammes of colza seeds. Referring to the drawings, the scales for Figures 16, 17, 18, are one-fifteenth actual size, and Figures 19, 20, 21, one-tenth.—*Machines, Outils et Appareils.*

IMPROVED DREDGER.

WE illustrate below a dredger of simple construction, well calculated for doing useful work on shallow streams. The barge is 54 ft. long, 22 ft. beam, and 6 ft. deep. Her draught of water is under 4 ft. Built by Rose, Downs & Thompson, Hull. Our drawing explains itself. It will be seen that we have here a swiveling crane and grab bucket, and that the stuff dredged can be loaded into the barge and conveyed where necessary. The lifting power of the crane is one ton, and in suitable material such a dredger can get through a great deal of work in a comparatively short time.—*Engineer.*



IMPROVED ONE-TON BUCKET DREDGER.

HISTORY OF THE FIRE EXTINGUISHER.

THE first fire extinguishers were of the "annihilator" pattern, so arranged in a building that when a fire occurred carbonic acid gas was evolved, and, if the conditions were right (as the mediums say), the fire was put out. It worked very nicely at experimental fires built for the purpose, but was apt to fail in case of an involuntary conflagration. About the year 1867 a patent was granted to Carlier and Vignon, of France, for an apparatus in which water saturated with carbonic acid gas was projected upon the fire by the expansive force of the gas itself. As the apparatus was portable and the stream could be directed to any point, it was obviously the desideratum needed. Mr. D. Miles, of Boston, purchased the American patent, and subsequently sold the territory, exclusive of New England, to the Babcock Co., who, at the time, had a crude apparatus of their own. The first machines sold under the new patent were filled with water and loaded with cartridges of dry acid and bicarbonate of soda—the cap screwed down hastily, and, as the chemicals dissolved, the gas was generated, the pressure raised, and the water charged by absorption. The pressure of some 80 pounds was sufficient to project a stream 50 feet or more, and the machine was set upon the shelf so as to be ready for any fire that might occur. In many cases, however, the pressure escaped after a short time, and the machine when needed was found to be useless.

The most important step in the evolution of the modern extinguisher was the adoption of a device for mixing liquid acid with the soda solution, by the turning of a handle or screw, *after* the alarm was given. This was a practical machine, and proved of such value that an immense business was built up. The result of this prosperity was the development of new companies with new devices for accomplishing the same result, which were successfully offered to the public with varying success.

As these were direct infringements upon the patent rights acquired by the Babcock Company, their encroachments were resisted in the courts, and much money was spent in the effort of the company to sustain their rights, including the purchase of the patents of several rival machines that possessed real merit or whose business was worth controlling. Among these purchases was the right and good will of the "National" Extinguisher Co., who used an acid cartridge of glass, the acid being liberated by breaking the glass. This feature, united with important improvements in general construction and the use of a peculiar glass bottle instead of a tube, is the Babcock machine of to-day, the combination making the simplest and most effective and reliable apparatus ever built. In the meantime, an investigation before the courts brought out the fact that the French patent was antedated by an American invention, for which a patent was applied by a Dr. Graham, in 1837, and which possessed the essential features of the principle in dispute. Graham, through lack of means, or for some other reason, had failed to perfect his papers up to the time of his death, and, as the invention was one of obvious importance, a bill was passed through Congress for the reopening of the case, and the patent was issued to the Graham heirs in 1878. Soon after the issue of the Graham patent, several extinguisher firms, viz., Charles T. Holloway, of Baltimore; W. K. Platt, of Philadelphia; S. F. Hayward, of New York; the Protection Fire Annihilator Co., of New York; the Babcock Manufacturing Co., of Chicago, and the New England Fire Extinguisher Co., of Northampton, Mass., were licensed to manufacture under the patent, by Archibald Graham, as administrator of the estate of his father, who bound himself in these licenses to issue no other licenses except with the approval of all those who were included in the combination. This arrangement left several enterprising manufacturers out in the cold, and one of these, in investigating the status of extinguisher patents at Washington, discovered an assignment of a quarter interest of the Graham patent to a Mr. Burton, who, at the time of Graham's second application for a patent, had assisted him with $500. This assignment had long been forgotten—Burton having died, and his heirs knowing nothing of its existence. The widow of Burton was hunted up, an assignment was secured for $30,000, and a consolidated fire extinguisher company was formed, which became the owner of the one-quarter interest in the patent. This combination, known as the "Fire Extinguisher Manufacturing Co.," included the Protective Annihilator Co., of New York; the Northampton Fire Extinguisher Co., of Northampton, Mass.; and the North American Fire Annihilator Co., of Philadelphia. The combination bought out the Babcock Co., who had already acquired the patents of the Champion Co., all the patents of the Conellies, of Pittsburg, and of the Great American Co., of Louisville, as well as the licenses of S. F. Hayward and W. K. Platt. This covers all the extinguisher patents in existence, except those of Charles T. Holloway, of Baltimore.

The advantages of the chemical engine are well summed up in the following statement:

The superiority of a chemical engine consists—

1st. In its simplicity. It dispenses with complex machinery, experienced engineers, reservoirs, and steam. Carbonic acid gas is both the working and extinguishing agent.

2d. In promptness. It is always ready. No steam to be raised, no fire to be kindled, no hose to be laid, and no large company to be mustered. The chemicals are kept in place, and the gas generated the instant wanted. In half the cases the time thus saved is a building saved. Five minutes at the right time are worth five hours a little later.

3d. In efficiency. Mere water inadequately applied feeds the fire, but carbonic acid gas never. Bulk for bulk, it is forty times as effective as water, the seventy gallons of the two smallest cylinders being equal to twenty-eight hundred gallons of water. Besides, it uses the only agent that will extinguish burning tar, oil, and other combustible fluids and vapors. One cylinder can be recharged while the other is working, thus keeping up a continuous stream.

4th. In convenience. Five or six men can draw it and manage it. Its small dimensions require but small area, either for work or storage. One hundred feet or more of its light, pliant hose can be carried on a man's arm up any number of stairs inside a building, or, if fire forbids, up a ladder outside.

5th. In saving from destruction by water what the fire has spared. It smothers, but does not deluge; the modicum of water used to give momentum to the gas is soon evaporated by the heat, doing little or no damage to what is below. This feature of the engine is of incalculable worth to housekeepers, merchants, and insurance companies.

6th. Economy. It costs only about half as much as a first class hand engine, and about one-fourth as much as a steam engine, with their necessary appendages, and the chemicals for each charge cost less than two dollars.

HOW TO TOW A BOAT.

A CORRESPONDENT of *Engineering News* says: Those living on swift streams, and using small boats, often have occasion to tow up stream. So do surveyors, hunters campers, tourists, and others. One man can tow a boat against a swift current where five could not row.

Where there are two persons, the usual method is for one to waste his strength holding the boat off shore with a pole, while the other tows. Where but one person, he finds towing almost impossible, and when bottom too muddy for poling and current too swift for rowing, he makes sad progress.

The above cut shows how one man can easily tow alone. The light regulating string, B, passes from the stern of the boat to one hand of the person towing, T. The tow line, A, is attached a little in front of the center of the boat. Hence when B is slackened the boat approaches the shore, while a very slight pull on it turns the boat outward. The person towing glances back "ever and anon" to observe the boat's line of travel.

RAILWAYS OF EUROPE AND AMERICA.

THE following table, which has been prepared by the French Ministry of Public Works, gives the railway mileage of the various countries of Europe and the United States up to the end of last year, with the number of miles constructed in that year, and the population per mile:

	Total.	Built in 1881.	Population per Mile.
Germany	21,313	331	2,154
Great Britain	18,157	164	1,939
France	17,134	895	2,170
Russia	14,745	3	5,586
Austria-Hungary	11,880	262	3,200
Italy	5,450	109	5,321
Spain	4,869	176	3,492
Sweden & Norway	4,616	273	1,408
Belgium	2,561	48	2,233
Switzerland	1,557	22	1,881
Holland	1,426	83	2,835
Denmark	1,053	25	1,919
Roumania	916	56	5,860
Turkey	866	—	2,891
Portugal	757	8	5,870
Greece	6	—	28,000
Total	107,306	2,455	3,168
United States	104,813	9,358	502

It appears from this that the United States mileage was only 2,493 less than the total of all Europe, and at the present time it exceeds it, as the former country has built about 6,000 miles this year, whereas Europe has not exceeded 1,500. The difference in the number of persons per mile in the two cases is also very great, Europe taking six times as many persons to support a mile of railway as the States, and can only be accounted for by the fact that American railways are constructed much cheaper than the European ones.

BEFORE IT HAPPENED.

AT 9 A.M. on Wednesday, September 13, the correspondent of a press agency dispatched a telegram to London with the intimation that the great battle at Tel-el-Kebir was practically over. It may possibly astonish not a few of our readers (says a writer in the *Echo*), to learn that this message reached the metropolis between 7 and 8 o'clock on the same morning; and, in fact, had an unbroken telegraphic wire extended from Kassassin to London, Sir Garnet Wolseley's great victory might have been known here at 6:52 A.M., or (seemingly) at a time when the fight was raging and our success far from complete. Nay, had the telegram been flashed straight to Washington in the United States, it would have reached there something like 1 h. 44 m. after the local midnight of September 12. Paradoxical as this sounds the explanation of it is of the most simple possible character. The rate at which electricity travels has been very variously estimated. Fizeau asserted that its velocity in copper wire was 111,780 miles a second; Walker that it only travels 18,400 miles through that medium during the same interval; while the experiments made in the United States during the determination of the longitudes of various stations there still further reduced the rate of motion to some 16,000 miles a second. Whichever of these values we adopt, however, we may take it for our present purpose, that the transmission of a message by the electric telegraph is practically instantaneous. But be it here noted, there is no such a thing as a *hora mundi* or common time for the whole world. What is familiarly known as longitude is really the difference in time, east or west, from a line passing through the north and south poles of the earth; and the middle of the great transit circle is the Royal Observatory at Greenwich. If in the latitude of London (51° 30′ N.), we proceed 10 miles and 1,383 yards either in an easterly or westerly direction, we find that the local time is respectively either one minute faster or one minute slower than it was at our initial point. Let us try to understand the reason of this. If we fix a tube rigidly at any station on the earth's surface, pointing to that part of the sky in which any bright star is situated when such star is due south (or, as it is technically called, "on the meridian"), and note by a good clock the hour, minute, and second at which it crosses a wire stretched vertically across the tube, then after a lapse of 23 h. 56 m. 4·09 s., will that star be again threaded on the wire. If the earth were stationary—or, rather, if she had no motion but that round her axis—this would be the length of our day. But, as is well known, she is revolving round the sun from left to right; and, as a necessary consequence, the sun seems to be revolving round her from right to left; so that if we suppose the sun and our star to be both on the wire together to-day, to-morrow the sun will appear to have traveled to the left of the star in the sky; and the earth will have that piece more to turn upon her axis before our tube comes up with him again. This apparent motion of the sun in the sky is not an equable one. Sometimes it is faster, sometimes slower; sometimes more slanting, sometimes

more horizontal. Thus it comes to pass that solar days, or the intervals elapsing between one return of the sun to the meridian and another, are by no means equal. So a mean of their lengths is taken by adding them up for a year, and dividing by 365; and the quantity to be divided to or subtracted from the instant of "apparent noon" (when the sun dial shows 12 o'clock), is set down in the almanac under the heading of "The Equation of Time." We may, however, here conceive that it is noon everywhere in the northern hemisphere when the sun is due south. Now the earth turns on her axis from west to east, and occupies 24 h. in doing so. As all circles are conceived to be divided into 360°, it is obvious that in one hour 15° must pass beneath the sun or a star; 30° in two hours, and so on. The longitude of Kassassin is, roughly speaking, 32° east, so that when the sun is due south there, or it is noon, the earth must go on turning for two hours and eight minutes before Greenwich comes under the sun, or it is noon there, which is only another way of saying that at noon at Kassassin it is 9 h. 52 m. A.M. at Greenwich. It is this purely local character of time which gives rise to the seeming paradox of our being able to receive news of an event before (by our clocks) it has happened at all.

THE ADER RELAY.

THIS new instrument has excited considerable interest among telegraph and telephone men by its exceeding sensitiveness. It is so sensitive to the passage of an electric current that a battery formed with an ordinary pin for one electrode and a piece of zinc wire for the other, immersed in a single drop of water, will give sufficient current to operate the relay. In practice it has successfully worked as a telephonic call on the Eastern Railroad Company's line between Nancy and Paris, a distance of 212 miles, requiring but two cups of ordinary Leclanché battery.

The instrument consists of two permanent horseshoe magnets, fixed parallel with each other and an inch apart. A very thin spool or bobbin of insulated wire is suspended, like the pendulum of a clock, between these permanent magnets, in such a manner that the bobbin hangs just in front of the four poles. A counterpoise is fixed at the top of the pendulum bar, which permits the adjusting of the antagonistic forces represented by the action of the swinging bobbin, and two springs, which are insulated from the mass, and which form one electrode of the local or annunciator circuit, while the pendulum bar forms the other.

It will be easily understood that as the bobbin hangs freely in the center of a very strong magnetic field (formed by the four poles of the two permanent magnets), the slightest current sent through the bobbin will cause the bobbin to be attracted from one direction, while it will be repelled from the other, according to the polarity of the current transmitted.

As the relay has a very low resistance, it is evident that it will become an acceptable auxiliary in our central office, particularly when used as a "calling off" signal, as by its use the ground deviation, so objectionable and yet so universally used for "calling off" purposes, can be entirely avoided, and the relay left directly in the circuit, as is being done here in Paris. R. G. BROWN.

Paris, September 12, 1882.

THE PLATINUM WATER PYROMETER.

By J. C. HOADLEY.

THE following description of the apparatus used for the determination of high temperatures, up nearly to the melting point of platinum, is offered in answer to several inquiries on the subject:

The object to be attained is a convenient and reasonably accurate application of the method of mixtures to the determination of temperatures above the range of mercurial thermometers, say 500° F., up to any point not above the melting point of the most refractory metal available for the purpose, platinum.

A first requisite is a cup or vessel of convenient form, capable of holding a suitable quantity of water, say about two pounds avoirdupois. Berthelot decidedly prefers a simple can of platinum, very thin, with a light cover of the same metal, to be fastened on by a bayonet hitch. For strictly laboratory work this may be the best form; but for the hasty manipulation and rough usage of practical boiler testing something more robust, but, if possible, equally sensitive, is required. The vessel I have used is represented in section in the accompanying cut, Fig. 1.

The inner cell, or true containing vessel, is 4·25 inches in diameter; and of the same height on the side, with a bottom in the form of a spherical segment, of 4·25 inches radius. It is formed of sheet brass 0·01 inch thick, nickel-plated and polished outside and inside. The outer case is 8 inches diameter and 8·5 inches deep, of 16-ounce copper, nickel-plated and polished inside, but plain outside. There are two handles on opposite sides, for convenience of rapid manipulation. The top, of the same copper as the sides and bottom, is depressed conically, like a hopper, and wired at its outer edge, forming a lip all around for pouring out of. The central cell is connected with the outer case only by three rings of hard rubber (vulcanite), each 0·25 inch thick, the middle ring completely insulating the cell from its continuation upward, and from the outer case. A narrow flange is turned outward at the upper edge of the cell, and a similar flange is also turned outward at the lower edge of the cylindrical continuation of the walls of the cell upward. Between these two flanges, the middle ring of hard rubber is interposed, and the two parts, the cell and its upward continuation, are clamped together by the upper and lower rings of hard rubber, which embrace the flanges and are held together by screws. The joints between the flanges and the middle ring of hard rubber, which might otherwise leak a little, are made tight with asphaltum varnish.

Fig 1 shows two partitions, dividing the space between the cell and the case into three compartments, and a concave false bottom. The cover is also seen to be divided into three compartments, by two partitions, and each compartment of the vessel and of its cover is provided with a small tube for inserting a thermometer. This construction was adopted in the first instruments made, for the purpose of observing the rate of heat transmission through the successive compartments, but these parts are without importance with respect to the practical use of the instrument, and may as well be omitted, as they considerably increase the cost, being nickel-plated and polished on both sides. The top and bottom plates of the cover are of 0·01 inch brass, nickel-plated and polished on both sides, both convex outward, the bottom plate but slightly, the top plate to 4·25 inches radius. A ring of hard rubber connects, yet separates and insulates these plates, and they are bound together with the ring into a firm structure by a tube of hard rubber, having a shoulder and knob at the top, and at the lower end a screw thread engaging with a thin nut soldered to the upper side of the bottom plate. When the cover is in place, its lower plate is even with the top of the cell; and the contained water, which nearly fills the cell, is surrounded by polished, nickel-plated, brass plates 0·01 inch thick, insulated from other metal by interposed hard rubber. The spaces between the cell and case (a single space if the partitions are omitted), the space above the hard rubber rings, and the space or spaces in the cover are all filled with eider-down, which costs $1.00 per ounce avoirdupois, but a few ounces are sufficient. Soft, fine shavings, or turnings of hard rubber, are said to be excellent as a substitute for eider-down. Heat cannot be confined by any known method. Its transmission can be in some degree retarded, and in a greater degree, perhaps, regulated. Some heat will be promptly absorbed by the sides, bottom, and cover of the cell, and by the agitator; but this does no harm, as its quantity can be accurately ascertained and allowed for. Some will be gradually transmitted to the eider-down, filling the spaces, and through this to the outer casing; but this can be reduced to a minimum by rapid and skillful manipulation, and its quantity, under normal conditions, can be ascertained approximately, so as not to introduce large errors. But varying external influences, such as currents of air, caused by opening doors, or by persons passing along near the apparatus during the progress of an experiment, which would introduce disturbing irregularities, can best be guarded against by such spaces as I have described, filled with the poorest heat-conductor and the lightest *solid* substance attainable. Air, although a poor heat-conductor, and extremely light, is diathermous, and offers no obstruction to the escape of radiant heat.

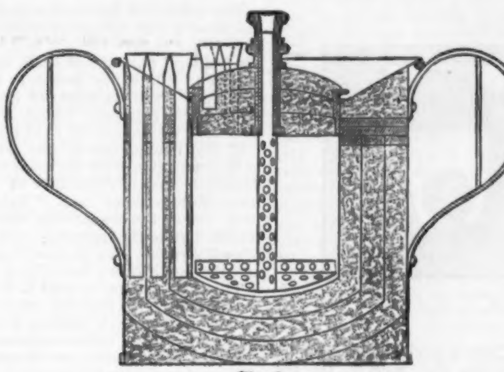


Fig. 1.

The agitator is an important part of the apparatus. Its object, in this instrument, is twofold. *First*, it serves to produce a uniform temperature throughout the body of water in the instrument; and *secondly*, it answers as a support to the heat-carrier of platinum or other metal, often intensely hot, which would injure or destroy the delicate metal of the bottom if allowed to fall on it. For this second purpose, no spiral revolving agitator, such as that commended by Berthelot, would suffice. The best form is such as I have shown in Fig. 1. A concave disk of sheet-brass, made to conform to the shape of the bottom of the cell, with a narrow rim turned up all around, of about 0·02 inch thickness, is liberally perforated with holes to lighten it, and to give free passage to water. The concave form causes the streams of water, produced by slightly raising and lowering the agitator, to take a radial direction downward or upward, so as to cross each other and promote rapid mixing. By a slight modification small vanes might be turned outward from the surface of the metal, which would produce mixing currents if the agitator were given a slight reciprocatory revolving motion, thus avoiding the alternate withdrawal and re-immersion of any part of the stem so strongly deprecated by Berthelot; but for several reasons I think an up and down motion of the agitator desirable in this instrument. The platinum heat-carrier, sometimes at a temperature of 2,500° to 2,800° F., is thereby brought into more rapid and forcible contact with the water, steam or water in the spherical condition is washed away from its surface, and by cooling it more rapidly, the duration of the observation is lessened, and errors due to transmission of heat through the walls of the instrument are diminished. The upper part of the agitator stem is of hard rubber, and the brass portion, which terminates at the under side of the cover when the agitator is in its lowest position, suspended by the shoulder at the upper end, need never be lifted for the purpose of mixing out of the hard rubber tube at the cover, so that loss of heat from this cause must be very slight. The brass tube is very freely perforated with holes to admit water, streaming radially through the holes in the agitator, to contact with the thermometer. The hole in the stem at the top is flared, to receive a cork, through which the thermometer is to be passed. The bulb of the thermometer should be elongated, and very slightly smaller in diameter than the stem. After passing it through the cork, a very slight band—a mere thread—of elastic rubber should be put around the bulb, near its lower end, or a thin, narrow shaving of cork may be wound around and tied on, to keep it from contact with the brass tube, for safety; and a little tuft of wool, curled hair, or hard rubber shavings should be put in the bottom of the brass tube to avoid accidents. For the same purpose, a light, but sufficient fender of brass wire, say 0·03 inch diameter, might be judiciously placed around the brass tube at a little distance, to protect it and the thermometer inside of it from shocks from the platinum ball when hastily thrown in, as it must always be. I have had delicate and costly thermometers broken for want of such a fender. Thermometers cannot be too nice for this work. For accurate work at moderate temperatures, they should be about 14 inches long, having a "safe" bulb at the upper end, with a range of 20° F.—32° to 52°—in a length of 10 inches, giving half an inch to a degree F., and carefully graduated to tenths of a degree, so that they can be read to hundredths, corresponding to single degrees of the heat-carrier in the normal use of the instrument.

For the determination of the highest temperatures, up closely to 2,900° F., it will be convenient to have thermometers of greater range, say 32° to 82° F., 50° in a length of 12·5 inches, or a quarter of an inch to a degree F., also graduated to tenths, or at the least, to fifths of a degree. Such thermometers will be about 17 inches long.

It is very satisfactory to have *two* instruments and a good outfit of thermometers and heat-carriers, in order to take duplicate observations for mutual verification and detection of errors.

HEAT CARRIERS.

For these platinum is greatly to be preferred to any other known substance. Its rather high cost is the only objection to its use. Its heat capacity is low, by weight, but its specific gravity is great, and sufficient capacity can be obtained in moderate bulk, while its high conductivity tends to shorten the duration of each experiment or observation. A convenient outfit for each instrument consists of three balls, hammered to a spherical form, one 1·1385 inches diameter, weighing 4,200 grains=0·6 pound avoirdupois; one 0·9945 inch diameter, weighing 2,800 grains=0·4 pound; and one 0·7894 inch diameter, weighing 1,400 grains=0·2 pound.

These can be obtained at 1⅔ cents per grain, and will cost, respectively, $70.00, $46.67, and $23.33, and collectively, $140.00. At the assumed specific heat of Pt=0·0333+, the heat capacity of the respective balls will be $\frac{1}{100}$, $\frac{1}{150}$, and $\frac{1}{300}$ of 2 pounds of cold water, and the two smaller balls used together will be equal to the larger one. Corrections for varying specific heat of platinum may be conveniently made by the tables given in a previous article.* Corrections for varying specific heat of water are less important, but may be made by the following table:

Temperatures, Fahrenheit, and Corresponding Number of British Thermal Units Contained in Water from Zero Fahrenheit.

Deg	B. t. u.	Deg.	B. t. u.	Deg.	B. t. u.	Deg.	B. t. u.
32	32·000	57	57·007	82	82·039	107	107·101
33	33·000	58	58·007	83	83·041	108	108·104
34	34·000	59	59·008	84	84·043	109	109·107
35	35·000	60	60·009	85	85·045	110	110·110
36	36·000	61	61·010	86	86·047	111	111·113
37	37·000	62	62·011	87	87·049	112	112·117
38	38·000	63	63·012	88	88·051	113	113·121
39	39·001	64	64·013	89	89·053	114	114·125
40	40·001	65	65·014	90	90·055	115	115·129
41	41·001	66	66·015	91	91·057	116	116·133
42	42·001	67	67·016	92	92·059	117	117·137
43	43·001	68	68·018	93	93·061	118	118·141
44	44·002	69	69·019	94	94·063	119	119·145
45	45·002	70	70·020	95	95·065	120	120·149
46	46·002	71	71·021	96	96·068	121	121·153
47	47·002	72	72·023	97	97·071	122	122·157
48	48·003	73	73·024	98	98·074	123	123·161
49	49·003	74	74·026	99	99·077	124	124·165
50	50·003	75	75·027	100	100·080	125	125·169
51	51·004	76	76·029	101	101·083	126	126·173
52	52·004	77	77·030	102	102·086	127	127·177
53	53·005	78	78·032	103	103·089	128	128·182
54	54·005	79	79·034	104	104·092	129	129·187
55	55·006	80	80·036	105	105·095	130	130·192
56	56·006	81	81·037	106	106·098	131	131·197

A composite heat-carrier, of iron covered with platinum, answers well for temperatures up to about 1,500° F. A ball of wrought iron 0·88 inch diameter will weigh 700 grains, and a capsule of platinum spun over it 0·048 inch thick, making the outside diameter 0·976+ inch, will also weigh 700 grains. Upon the assumption of 0·0333+ for the specific heat of Pt and 0·1666+ for that of Fe, the composite ball will have a heat capacity equal to that of 4,200 grains of Pt, and equal to 0·01 of that of 2 pounds of cold water. A patch, about 0·35 inch diameter, has to be put in to close the orifice where the Pt capsule is spun together, and a slight stain will show itself at the joint around this patch, from oxidation of the iron, but the latter will be pretty effectually protected. Difference of expansion, which will not exceed 0·007 inch in diameter, will not endanger the capsule of Pt. The interruption of conductivity at the surface contact of the two metals makes the process of heating and cooling a little slower, but not noticeably so.

Such composite balls can be obtained for $20 each, $50 less than the cost of an equivalent ball of solid platinum, which is preferable in all but cost. Iron balls could be used for a few crude determinations. Cast iron varies too much in composition, and wrought iron oxidizes rapidly. While the oxide adheres it gains in weight, and when scales fall off it

* *Journal* for August, pp. 97, 98, and errata in *Journal* for September, p. 172.

loses; and the specific heat of the oxide differs from that of metallic iron. Whatever metal is used, care must be taken to apply the appropriate tabular correction for PtFe, or Pt and Fe.

MANIPULATION.

Small graphite crucibles with covers, as shown in section, in Fig. 2, serve to guard against losing the ball, to handle it by when hot, and to protect it against loss of heat during transmission from the fire to the pyrometer. To guard against overturning the crucibles, moulded firebrick should be provided to receive them, two crucibles being put into one brick, in the same exposure, whenever great accuracy is desired, each serving as a check on the other, and their mean being likely to be more nearly correct than either one if they differ. The firebrick cover is occasionally useful to retard cooling, if, by reason of local obstructions, some little delay is unavoidable in transferring the balls from the fire to the water of the pyrometer. With convenient arrangements, this may be done in three seconds. After observing the temperature of the water, make ready for the immersion of the heat carrier by raising the agitator until a space of only about 1·5 of an inch is left between its rim and the cover. An instant before putting in the heat carrier—"pouring" it from the crucible—lift the cover and agitator both

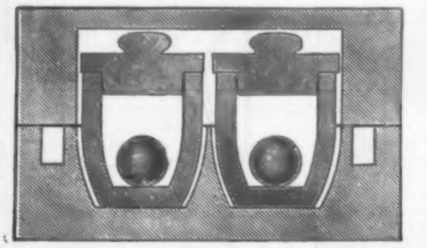


Fig. 2.

together, so that the rim of the latter is level with the sloping top of the instrument. The agitator then receives the hot ball without shock, and no harm is done. If the ball goes below the agitator, it is likely to injure the bottom of the cup. If, on taking the temperature of the water before the immersion of the heat carrier, any change is observed, either rising or falling, the direction and rate of such change, and the exact interval of time between the last recorded observation and the immersion, should be noted, in order to determine the exact temperature of the water at the instant of immersion. The temperature of the water will continue to rise as long as the heat carrier gives out heat faster than the cell loses it. The rise will grow gradually slower until it ceases, and the maximum can be very accurately determined. Examples of the mode of using the tables, and of determining the true temperature of the heat carrier at the instant of immersion from the observations with the instrument, are given in the table on pages 170 and 171 of this Journal for September. A method of using the tables, by which a closer approximation to the true temperature may be reached, will be pointed out in a subsequent article.

DETERMINATION OF THE CALORIFIC CAPACITY OF THE METALS OF THE PYROMETER, in terms of water, *i. e.*, in British thermal units.

First. Weigh the cup, or cell, the lower plate of the cover and the metallic portion of the agitator, and compute their heat-capacity by the specific heat of the respective metals. Compute also the heat capacity of the thermometer; or, if it be long, of so much of it as is found to share nearly the temperature of the immersed portion. The result will be a minimum—indeed, in so small a vessel the inevitable loss by conduction and radiation will amount to more than one-third as much as the simple heat capacity of the metals.* The total must be ascertained by an application of the method of mixture. Ascertain the temperature of the interior of the instrument simply; pour in quickly but carefully a known quantity of water, say about two pounds, of known temperature, say about 100° F., and ascertain the temperature as soon after pouring as mixing can be properly performed. But a correction is necessary for loss of heat in the act of pouring. To ascertain the amount of this correction prepare a bath of tepid water, and bring all parts of the instrument—outside, inside, and interior portions, together with the vessel to pour from—exactly to one common, carefully ascertained temperature. Now take two pounds of the water and pour it into the cell in the same manner as before. Exposure of so thin a stream on two surfaces to the air of the room will produce a certain degree of refrigeration in the water, which is supposed to be warmer than the air, say at about 160° F. This effect will be due to conduction, by contact with the air, to radiation, and to evaporation; and by so much the refrigeration observed in mixing is to be diminished.

Four experiments, carefully conducted, gave the following results:

Loss of temperature by pouring at 170° F., 0·81°, 0·86°, 1·00°, and 1·07° F.; mean, 0·935° F.

The following are values of the calorific capacity of my pyrometers, that is, of those parts of each which share directly the temperature of the inclosed water, including the thermometer to be used with the instrument, and the heat communicated to the eider-down and otherwise lost during an observation, expressed in decimals of a British thermal unit, or in decimals of a pound of cold water:

0·1048, 0·1052, 0·1077, 0·1008, 0·1028, and 0·1104.

Mean	0·1053 =	0 lb.	1 oz.	11 drms.
Add water.....	1·8947 =	1 "	14 "	5 "
	2·0000 =	2 "	0 "	0 "

This was the value used. The instrument, being put on delicate coin scales and counterbalanced, weights equal to 1·8947 lb. avoirdupois = 1 lb. 14 oz. 5 drms., were added to the counterbalancing weights, and cold water was poured in until the scales again balanced.

The pyrometer with its contained water was then just equal in heating capacity, while the temperature was not above 38° F. to two pounds of cold water. The two instruments were sensibly alike, but were numbered No. 1 and No. 2, and at each observation the one used was noted.

The process of preparation and testing appears long and tedious, and is indeed somewhat so; but the instruments once well made are durable, convenient in use, and with care reasonably accurate.

Compared with mercurial thermometers between 212° and 600° F., I believe them to be much more accurate, although less convenient.

For a range of temperatures from 212° to 900° F. they are certainly more trustworthy than anything save an air thermometer of suitable construction; and for all temperatures from 800° to 900° F. up nearly to the melting point of platinum they are without a rival, so far as I know.

For some situations the ball can best be inserted in the fire or other situation where an observation is desired, and withdrawn for immersion by means of long, slender tongs, with jaws resembling bullet moulds.

A word about the melting point of platinum. My balls certainly began to melt below 2,950° F., but I am by no means sure that they do not contain any silver, although their specific gravity gives assurance that they are at least nearly pure.—*Franklin Journal.*

* In our case the heat-capacity, thermometer included, was 0·0757; total, 0·1053; radiation, etc., 0·0296. Respectively, 71·9 per cent. and 28·1 per cent. of the total.

LOCOMOTIVE PAINTING.*

By JOHN S. ATWATER.

THE subject of locomotive painting has been pretty well discussed at the former meetings of the association, and we have heard many excellent suggestions regarding the use of oils, mineral paints, and leads from gentlemen of long experience. But as the secretary has invited a display of my ignorance I will endeavor to explain as clearly as possible the methods I pursue, which, though not new or original, have been productive of good results.

If time enough can be had we can prime with oil alone, or in connection with the leads or minerals, and be sure of durability; but in these days of "lightning speed," "lightning illuminations," and "lightning painting," we must look about for something with "chain lightning" in it, which, unlike the lightning, will remain bright and stick after it strikes. We all have to paint according to the time and the facilities we have for doing the work.

The scale on iron or steel is the only serious trouble which the painter has to contend with. Rust can be removed or utilized with the oil, making a good paint, but unless time can be given it is better to remove the rust.

If possible let tanks get thoroughly rusted, then scrape off scale and rust with files sharpened to a chisel edge, rub down large surfaces with sandstone, and use No. 3 emery cloth between rivet heads, etc., then wash off with turpentine. This will give you a good solid surface to work upon.

For priming I use 100 pounds white lead (in oil), 10 pounds dry red lead, 13 pounds Prince's metallic, 8 quarts boiled oil, 2 quarts varnish, 6 quarts turpentine, and grind in the mill, as it mixes it thoroughly with less waste. I mix about 250 pounds at a time (put into kegs and draw off as wanted through faucets).

This *o-le-ag-in-ous* compound can be worked both ways, quickly by adding japan, slower by adding oil, and reduce to working consistency with turpentine.

Without the oil or japan it will dry hard on wrought iron in about seven days, on castings in about four days. When dry putty with white-lead putty, thinned with varnish and turpentine, and knifed in with a "broad-gauge" putty knife. Next day sandpaper and apply first coat rough-stuff, which is, equal parts, in bulk, white lead and "Reno's umber," mixed "stiff" with equal parts japan and rubbing varnish, and thin with turpentine. Next morning, second coat rough-stuff, made with Reno's umber, fine pumice stone, japan, and turpentine. At 1 o'clock P.M. put on guide coat for the benefit of the small boys, which is rough-stuff No. 2, darkened with lamp-black and very thin. The addition of fine pumice to rough-stuff No. 2 encourages the boys in rubbing, and prevents the blockstone from clogging.

By the time the last end of the tank is painted the first end is ready for rubbing, though it is better to stand until next day.

After rubbing sandpaper and put on very thin coat of varnish and turpentine (about equal parts). This soaks into the filling, bardening it and making a close, smooth, elastic surface, leaving no brush marks and being more durable than a *quick*-drying lead. This can be rubbed with fine sandpaper or hair to take off gloss, and colored the next morning, but it is better to remain 24 hours before coloring.

Upon this surface an "all japan color" would, before night, resemble a map of the war in Egypt, but by adding varnish and a very little raw oil to the "japan color," making it of the same nature as the under surface, will prevent cracking.

If I sandpaper in the morning, I put on first-coat color before noon. Second ditto afternoon, and varnish with rubbing varnish that night; rub down, stripe and letter next day, though I consider it better to stripe and letter on the color, and varnish with "wearing body varnish."

The tank is then ready for mounting. When mounted I paint trucks and woodwork, two coats lead, color, "color and varnish," and finish the whole with "wearing body varnish." Time, from 14 to 16 days.

On cabs I use the same priming as on tanks, let stand five days, putty nail holes and "plaster putty" hard wood, and give two coats lead, mixed as follows: 100 pounds keg lead, 19 pounds Reno's umber, 3½ quarts japan, 1¼ quarts varnish, 6 quarts turpentine. I call this "No. 2 lead," and allow 24 hours between coats, then apply a coat of No. 2 "rough stuff" at 7 A.M. Rub down at 10 A.M. two coats color, and varnish before 6 P.M. Striped and lettered next day and finished on the following day if it is not taken away from me, and put on the engine. Time, eleven days. Can be done in five days.

On castings, same priming, putty and "No. 2 lead" if time is allowed. I use rough-stuff No. 2 on all flat places, rub down and give two coats of No. 2 lead. Also painting inside of all castings, and sheet iron casings; and inside of boiler jacket, with "Prince's metallic."

All castings I get ready for color before they are put on the locomotive, except such as have to be filed or fitted on outside edges. As there is very little time given to finish a locomotive after the machinists get through, I usually finish it *the day before it is done.*

As a sample (one of many), an 8—17—C. locomotive boiler tested Saturday afternoon, August 12, boiler painted, with 120 pounds steam on, wheels put under, boiler covered, cab put on, and finished Monday, August 14, at midnight (did not work Sunday); primed, puttied, colored, lettered, and varnished same day. After 10 o'clock at night the painters have a chance, and it is their glorious privilege to work until morning. The machinists have all the time there is, the painters have what is left.

* A paper read before the Master Car Painters' Association, Chicago, September, 1882.

So much for the ordinary way. For a quicker method of painting tanks I send a sample marked No. 1. Time, including first coat varnish, five days. Priming, 1 pound Reno's umber to 2 quarts pellucedite; two coats rough-stuff, composed of umber and pellucedite, rubbed down, and thin coat of pellucedite; one coat drop black, one coat rubbing varnish; exposed to weather (southeasterly exposure near salt water) March 12, 1879; revarnished one coat, finishing September 1, 1879; remained out until March 22, 1880. Total exposure, one year and one and a half weeks; thrown around the shop until August, 1882; has been painted three years and six months. This is not a sample of good work, but of quick and rough painting. Considering the time and usage it has experienced it has stood much better than I expected, though I cannot safely recommend that kind of painting when any other can be followed.

Sample No. 3—Time, including two coats varnish, 14 days. Painted as described in first part of this article; exposed in same places as No. 1, April 3, 1880; total exposure, six months; has been painted two years and five months.

The above are not exactly "Thoughts on Locomotive Painting." What my thoughts are would require several dictionaries to express; but that is owing, not to the kind of work, but having to produce certain results in a time that will not insure good, durable work.

For removing old paint on wood I use a burner. From iron, I have found the quickest and most effectual way is to dissolve as much sal soda in warm water as the water will take up, and mix with fresh lime, making a thick mortar; spread this on the tank, about an inch thick, with a trowel; when it begins to crack, which will be in a few minutes, it has softened the paint enough, so that with a wide putty knife you can take it all off; then wash off tank with water. This takes off paint, rust, and everything, including the skin from your hands, if you are not careful. Plaster one side of tank, and use mortar over again for the other side.

Engine oil used to brighten smoke stacks, no matter with what painted, will cause blistering. Tallow and "japan drop black" mixed, and apply while stack is hot, with an occasional rubbing over with the same, will remain bright a long time.

Rust always contains dampness, and will feed on itself, extending underneath and destroying solidly painted surfaces. It is, therefore, necessary, in order to secure good results, that the rust should be killed before priming, or that the priming be so mixed that it will assimilate with the rust and prevent spreading.

Steel tanks will not rust as rapidly as iron, but the scale is more apt to flake off by the expansion and contraction of the metal, taking the paint with it.

Heated oil, or heated oil priming, will dry faster and be more penetrating than cold. I consider heated "boiled oil" and red lead the best primer for iron.

In regard to ornamentation, my *taste* is governed by the fact that I work "by contract," and get no more for a highly ornate locomotive than I do for a plain one, therefore I like the *plain ones best*, and I hope that our "good brother Burch's" prophecy, that "the days of 'fancy locomotives' will return," will never be fulfilled until after I go out of the business. There is a happy medium between a hearse and a circus wagon, and the locomotive painter, when not tied down by "specifications," can produce a neat and handsomely painted engine without the "spread eagle" or "star spangled banner." My own ideas are in the direction of simple lines of striping, following the lines of the surfaces upon which they are drawn.

Finally, take all the time you can get, the more the better, and use *oil* accordingly.

"CRACKLE" GLASS.

AN ingenious process of producing glass with an iced or crackled surface, suitable for many decorative purposes, has been invented in France by Bay. The product appears in the form of sheets or panes, one side of which is smooth or glossy, like common window glass, while the other is rough and filled with innumerable crevices, giving it the frozen or crackled appearance so much admired for many decorative purposes. This peculiar cracked surface is obtained by covering the surface of the sheet on the table with a thick coating of some coarse-grained flux mixed to form a paste, or with a coating of some more easily fusible glass, and then subjecting it to the action of a strong fire, either open or in a muffle. As soon as the coating is fused, and the table is red-hot, it is withdrawn and rapidly cooled. The superficial layer of flux separates itself in this operation from the underlying glass surface, and leaves behind the evidence of its attachment to the same in the form of numberless irregularities, scales, irregular crystal forms, etc., giving the glass surface the peculiar appearance to which the above name has been given. The rapid cooling of the glass may be facilitated with the aid of a stream of cold air, or by continuously projecting a spray of cold water upon it. By protecting certain portions of the glass surface from contact with the flux, with the use of a template of any ornamental or other desired form, these portions will retain their ordinary appearance, and will show the form of the design very strongly outlined beside the crackled surface. In this manner, letters, arabesque, and other patterns in white or colored glass can be produced with great ease and with fine effect.

HOW MARBLES ARE MADE.

MARBLES are named from the Latin word "*marmor*," by which similar playthings were known to the boys of Rome, 2,000 years ago. Some marbles are made of potter's clay and baked in an oven just as earthenware is baked, but most of them are made of a hard kind of a stone found in Saxony, Germany. Marbles are manufactured there in great numbers and sent to all parts of the world, even to China, for the use of the Chinese children.

The stone is broken up with a hammer into pieces, which are then ground round in a mill. The mill has a fixed slab of stone, with its surface full of little grooves or furrows. Above this a flat block of oak wood of the same size as the stone is made to turn round rapidly, and, while turning, little streams of water run in the grooves and keep the mill from getting too hot. About 100 pieces of the square pieces of stone are put in the grooves at once, and in a few minutes are made round and polished by the wooden block.

China and white marbles are also used to make the round rollers which have delighted the hearts of the boys of all nations for hundred of years. Marbles thus made are known to the boys as "chinas," or "alleys." Real china ones are made of porcelain clay, and baked like chinaware or other pottery. Some of them have a pearly glaze, and some are painted in various colors, which will not rub off, because

they are baked in, just as the pictures are on the plates and other tableware.

Glass marbles are known as "agates." They are made of both clear and colored glass. The former are made by taking up a little melted glass on the end of an iron rod and making it round by dropping it into a round mould, which shapes it, or by whirling it around the head until the glass is made into a little ball.

Sometimes the figure of a dog or squirrel or a kitten or some other object is put on the end of the rod, and when it is dipped into the melted glass the glass runs all around it, and when the marble is done the animal can be seen shut up in it. Colored glass marbles are made by holding a bunch of glass rods in the fire until they melt; then the workmen twist them round into a ball or press them into a mould, so that when done the marble is marked with bands or ribbons of color. Real agates, which are the nicest of all marbles, are made in Germany, out of the stone called agate. The workmen chip the pieces of agate nearly round with hammers and then grind them round and smooth on grindstones. —*Philadelphia Times.*

DRAWING-ROOM PHOTOGRAPHY.

AMONG the examples we have received are some which would certainly do credit to any professional artist, alike for the posing, lighting, and general treatment; indeed, we may say that some of the poses are of a high artistic order, and quite a relief from the conventional positions and accessories so frequently seen in professional work. The expressions secured are also, as a rule, unusually pleasing and natural. This is, no doubt, in a great measure due to the sitter feeling more at ease in the amateur friend's drawing-room than in a stranger's studio. Particularly is this the case in some excellent work—full-length pictures—sent from the other side of the Atlantic, and taken in a room of very modest dimensions, and with only one window. Among the failures (if such they may be called) the chief fault lies in the lighting, and from either under or over exposure—the former chiefly arising when a landscape lens was used, and the latter when a portrait combination was employed. Some correspondents also complain of the long exposure that, in their case, had been imperative; but, curiously enough, with all the successful pictures a very brief exposure has always been mentioned, and generally with an exceedingly small window.

With a view to the further assistance of those who have met with difficulties, we recur again to the subject of the lighting, for upon this must entirely depend the success or failure in producing satisfactory results; and, as we explained in previous articles, unless proper *chiaroscuro* is secured on the model, it will be impossible to obtain it in the picture. The chief defect in this respect has been either that the light has been too abrupt, and consequently the high lights are very white and the shadows heavy, giving the pictures an under-exposed appearance, or the face is devoid of shadow, one side being as light as the other; hence it lacks the roundness necessary to constitute a good picture. In most instances the former defect has arisen from the reflecting screen not being properly placed so as to reflect back the light in the right direction, or it has been too far from the model; hence it has lost the greater part of its value. It should be borne in mind that the nearer the sitter is to the source of light the nearer the reflector must be to him, and also that at whatever angle the light falls upon the reflector it is always thrown off at a corresponding one.

Now, supposing that the light falls upon the model at an angle of, say, 40°: we shall have to place our reflecting screen at somewhat the same angle, and the nearer it is approached the greater will be the effect produced. If the sitter be placed very close to the window and the reflector a long way off, or if it project the light in a wrong direction, it is manifest that in the resulting pictures the shadows will, of necessity, be heavy, and the negative will have an under-exposed appearance, however long may have been given, simply because there was no harmony in the lighting of the model. In the case where the picture has been flat it has arisen from the sitter being placed too far back from the window, so that the direct light falling upon him has been too feeble to produce any strong lights, and the reflector arranged so that it received a stronger illumination than the model, then reflecting it on to the latter, quite overpowering the dominant lights. The remedy for this is simply to bring the sitter more forward, so as to obtain a stronger dominant light.

With regard to the time of exposure: we must again impress upon the student the necessity for placing the sitter as close to the window as can be conveniently done, for then he will receive the strongest illumination; and, no matter how strong the shadows which may be produced, they can always be modified sufficiently by the judicious use of the reflector. Of course, in practice there is a limit as to the closeness the sitter can be placed, inasmuch as if too near there will not be room enough for the background. As we have before said, the effective light falling upon the sitter is governed by the amount of direct skylight to which he is exposed. For experiment, let any one seat himself, say, one foot from the window and sideways to it, and note the amount of sky that can be seen from this position, then take a seat six feet within the room, and note it from thence. The difference will be very marked indeed, and it will fully account for the long exposure that some have found imperative.

In our previous articles we directed special attention to the advantage accruing from arranging the sitter in such a position that he received as much direct light as possible, so that it practically helps to soften the shadows; hence the sitter should be placed so that he is turned as little away from the source of light as will enable the desired view of the face being obtained. That this may the more advantageously be done the camera should always be placed as close as possible to the side wall in which the window is situated. As an experiment illustrating the advantage of this: let a camera be placed close to the wall, then the sitter arranged so that from that point of view a three-quarter face is obtained, and it will be noticed that there is very little need of the reflector at all. Let a negative now be taken, and the camera brought, say, five feet into the room, and the sitter, without changing his seat, turned round until a similar view of the face is obtained from that point. It will now be seen that the shadows are very much deeper than before, and the reflector will have to be brought pretty close in order to overcome them; nevertheless they may be obtained quite as soft and harmonious as in the former case. Let a second negative now be taken, giving the same exposure as before, and it will be found that if the first one were correctly timed the second will be considerably under-exposed. Yet the sitter was at the same distance from the window in each case.

This shows the advisability of utilizing all the direct light it is possible to do, and thereby leaving as little as we can to be accomplished by the reflector. When the sitter is arranged to the best advantage at a window of ordinary size, fully exposed pictures can generally be obtained with a portrait lens (full opening) in fairly good light, on moderately sensitive plates, with one or two seconds' (or even less) exposure. If a longer exposure than this be necessary, it may fairly be assumed that the lighting has not been properly managed.—*British Journal of Photography.*

A NEW METHOD OF PREPARING PHOTOGRAPHIC GELATINE EMULSION BY PRECIPITATION OF THE BROMIDE OF SILVER.

By FRANZ STOLZE, Ph.D.

I CONSIDER the method of precipitation described below as far superior to any other hitherto employed, particularly on account of its infallible certainty. I began at first with a thirtieth of the whole quantity of gelatine, and increased that quantity to a tenth without the precipitate forming with greater difficulty. The salts were dissolved in the usual quantity of water, the bromide of potassium was added to the separately-dissolved gelatine, and both solutions cooled in iced water. I soon found that even this was not necessary. I accelerated the solution of the salts by vigorous agitation, so that the temperature became so much lowered that, even after the addition of the warm gelatine, it still remained low enough to give the precipitate when mixed. The mixing took place gradually, all the usual precautionary measures being observed; such as pouring the silver solution into No. 2 in small quantities at a time, and constantly stirring, and the separation from the mother lye was complete.

The formula according to which I worked latterly was as follows:

SOLUTION I.

Nitrate of silver	463	grains.
Water	16⅔	ounces.

SOLUTION II.

Bromide of potassium	355	grains.
Iodide of potassium	15	grains.
Gelatine	46	grains.
Water	16⅔	ounces.

After the mixing is completed the perfect separation of the precipitate takes place in four minutes at most. The clear fluid may be decanted off almost to the last drop, after which the precipitate is washed three times with water. In order to dissolve the precipitate pour over it a solution of 1·5 part of bromide of potassium in 100 parts of water, agitate, and then add a solution formed of 8 parts of ammonia of the usual strength in 600 parts of water. The emulsification will begin at once without any further heating. When now heated on the water bath—already at from 95° F. to 104° F.—the whole precipitate will be suspended, and thin films of the emulsion, when looked through, will have a grayish tint, but when dry they will appear partially red. Digestion at 104° F. is continued—from half an hour to an hour is usually long enough—until the film, even when dry, remains violet through and through. The remaining gelatine, 450 grains dissolved in 16 ounces of warm water, is then added, filtered, and plates coated with the resultant emulsion. But if it be desired to prepare emulsion for storage, wash the precipitate finally with alcohol, and store it either under alcohol or dry it as usual. To use it dissolve in the manner described above and mix with gelatine.

The great advantages of this process are evident. Not only is the troublesome washing saved, but, what is more important, the great mass of the gelatine is added to the emulsion in a condition which secures to the film a hitherto unattainable firmness. Also, it enables one to prepare a keeping emulsion with a minimum of alcohol, and, since the quantity of gelatine in the original emulsion is so small, it dries, when it is not desired to keep it under alcohol, so much more rapidly, and thereby also furnishes a more constant preparation.

I am convinced that this process is as yet but in its infancy, and that it is susceptible of great improvement. From the purely theoretical standpoint, the property possessed by gelatine, of combining in sufficiently cold solutions with bromide of silver in the nascent state, and falling to the bottom in a flaky condition, is exceedingly interesting. Evidently this property plays a part in the preparation of emulsion which has not until now been recognized. I do not doubt that it may be possible to effect, by a sufficiently low temperature, precipitation even from solutions rich in gelatine, if experiments in that direction were set on foot. What influence variations in temperature may have upon the subsequent sensitiveness of the emulsion, and whether the action of the ammonia and the bromide of potassium is more energetic, in the absence of the elsewhere-present nitric salts, are questions which can only be answered after thorough examination; and the parts played by the various additions of iodide or chloride of silver in this method of emulsification must likewise also be ascertained by experiment. The object of this article is to point out this rich province for research, and to induce experimenters to turn their attention to it; for it is only after the behavior of emulsion under all these conditions has been thoroughly examined that we can hope to reap the best results from the new process.—*Wochenblatt.*

TAYLOR'S FREEZING MICROTOME.

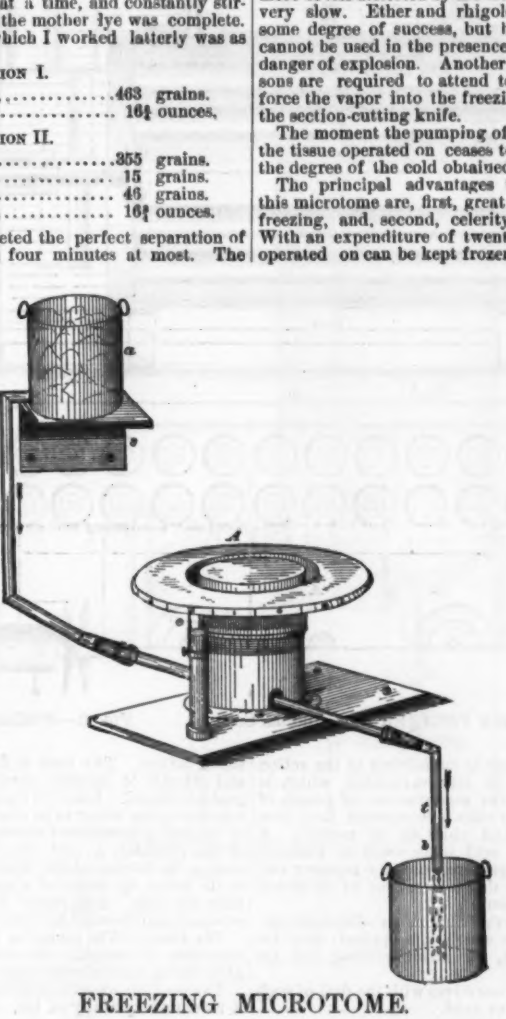
THIS microtome presents all the advantages of any plan heretofore employed in hardening animal or vegetable tissues for section cutting, while it has many advantages over all other devices employed for the same purpose.

Microscopists who are interested in the study of histology and pathology have long felt the necessity for a better method of freezing animal and vegetable tissue than has been heretofore at their command.

In hardening tissues by chemical agents, the tissues are more or less distorted by the solutions used, and the process is very slow. Ether and rhigolene have been employed with some degree of success, but both are expensive, and they cannot be used in the presence of artificial light, because of danger of explosion. Another disadvantage is that two persons are required to attend to the manipulations, one to force the vapor into the freezing box, while the other uses the section-cutting knife.

The moment the pumping of the ether or rhigolene ceases, the tissue operated on ceases to be frozen, so ephemeral is the degree of the cold obtained by these means.

The principal advantages to be obtained by the use of this microtome are, first, great economy in the method of freezing, and, second, celerity and certainty of freezing. With an expenditure of twenty-five cents, the tissues to be operated on can be kept frozen for several hours at a time. Small objects immersed in gum solutions are frozen and in condition for cutting in less than one minute.



FREEZING MICROTOME.

The method of using this microtome can be understood by reference to the illustration. A represents a revolving plane, by which the thickness of the section is regulated, in the center of which an insulated chamber is secured for freezing the tissue. It resembles a pill-box constructed of metal. A brass tube enters it on each side. The larger one is the supply tube, and communicates with the pail, *a*, situated on bracket, *s*, by means of the upper tube, *t*. To the smaller brass tube is attached the rubber tube, *t b*, which discharges the cold salt water into a pail placed under it. (See *b*.) The salt and water as it passes from pail, *a*, to pail, *b*, is at a temperature of about zero. The water should not be allowed to waste. It should be returned to the first pail for continual use, or as long as it has freezing properties. As a matter of further economy, it is necessary to limit the rate of exit of the freezing water. This is regulated by nipping the discharge-tube with the spring clothes pin supplied for the purpose. Should the cold within the chamber be too intense, the edge of the knife is liable to be turned and the cutting will be imperfect. When this occurs the flow of water through the chamber is stopped by using the spring clothes-pin as a clip on the upper tube. In order to regulate the thickness of the tissue to be cut a scale is engraved on the edge of the revolving plate, A, which, in conjunction with the pointer, *e*, indicates the thickness of the section.—*Microscopical Journal.*

THE ST. GOTHARD TUNNEL.—It appears that the traffic through the St. Gothard Tunnel has increased, since the inauguration of through international services, to such an extent that the Company have already obtained sanction for laying the second pair of rails in the tunnel. The Great Eastern Railway Company has increased its steamer traffic, and built additional station accommodation at Harwich.

VINCENT'S CHLORIDE OF METHYL ICE MACHINE.

Chloride of methyl was discovered in 1840 by Messrs. Dumas and Peligot, who obtained it by treating methylic alcohol with a mixture of sea salt and sulphuric acid. It is a gaseous product at ordinary temperature, but when compressed and cooled, easily liquefies and produces a colorless, neutral liquid which enters into ebullition at 287·7° above zero and under a pressure of 0·76 m.

Up to recent times, chloride of methyl in a free state had received scarcely any industrial application, by reason of the difficulty of preparing it in a state of purity at a low price. Mr. C. Vincent, however, has made known a process which permits of this product being obtained abundantly and cheaply. It consists in submitting to the action of heat the hydrochlorate of trimethylamine, which is obtained as a by-product in the manufacture of potash of beets. The hydrochlorate is thus decomposed into free trimethylamine, ammonia, and chloride of methyl. A washing with hydrochloric acid takes away all traces of alkali, and the gas, which is gathered under a receiver full of water, may afterward be dried by means of sulphuric acid, and be liquefied by pressure.

Pure liquid chloride of methyl is now an abundant product. There are two uses to which it is applied: first, for producing cold, and second, for manufacturing coal tar colors.

At present we shall occupy ourselves with the first of such applications—the production of cold.

The apparatus serving for the production of cold by this material are three in number: (1) the *freezer* (Figs. 1, 2, and 3), in which is produced the lowering of temperature that converts into ice the water placed in carafes or any other receptacles; (2) the *pump* (Figs. 4, 5, and 6), which sucks the chloride of methyl in a gaseous state up into the freezer and forces it into the liquefier; and (3) the *liquefier*, which is nothing else than a spiral condenser in which the chloride of methyl condenses, and from thence returns to the freezer to serve anew for the production of cold.

The Freezer.—This consists of a rectangular iron tank, 1 meter × 1 meter × 1·5 meters, containing a galvanized plate iron cylinder, A, kept in place by iron supports. This cylinder contains 24 horizontal tubes, which are open at the ends and riveted to vertical plates like those of tubular steam boilers. The tank is filled with a mixture of water and chloride of calcium, forming, as well known, an incongealable liquid. Into this liquid are plunged the receptacles containing the water to be converted into ice. The chloride of methyl is introduced through the cock, B, into the body of the cylinder, A, and surrounds and cools the tubes, as well as the incongealable liquid uninterruptedly circulating in the latter, by means of a helix, C, set in motion by a belt from the shop. This liquid is thus greatly lowered in temperature and freezes the water in the receptacles.

The Pump.—The pump in the larger apparatus has two chambers of unequal diameter, that is to say, it operates after the manner of compound engines.

The machine under consideration, being one that produces a moderate quantity of ice, has but a single chamber, as shown in Figs. 4, 5, and 6. It is a suction and force pump, whose piston, E, is solid and formed of two parts, which are set into each other, and the flanges of which hold a series of bronze segments.

The chamber, properly so-called, is of iron, cast in one piece, and is surmounted with a rectangular tank, F, in which constantly circulates the cold water designed for cooling the sides of the cylinder; these latter always tending to become heated through the compression of the methyl chloride.

The cylinder heads are hollowed out in the middle, and carry the seats of the suction valves. Each of the latter communicates with a chamber, G G¹, in which debouches the pipe, H, communicating with the cylinder, A, of the freezer (Figs. 1, 2, and 3).

Above the cylinder there are two delivery valves which give access to the chamber, D, communicating with the worm of the liquefier (Fig. 7) through the pipe, J.

The piston of the pump is set in motion by a pulley, K, and a cranked shaft actuated by a belt from the shafting. The piston head is guided by a slide keyed to the frame.

The Liquefier.—This apparatus consists of a cylindrical tank, L, of 3 mm. thick boiler plate, mounted vertically on a masonry base and designed to be constantly fed with cool water. It contains a second cylindrical tank, M, of 6 mm. thick galvanized iron. This latter tank is provided with a cast-iron cover, on which are mounted the worm, N, and a pipe, O, connected with the tube of the pressure gauge. To the base of the tank, M, there is affixed, on a cast iron thimble, a cock, P, for setting up a communication between

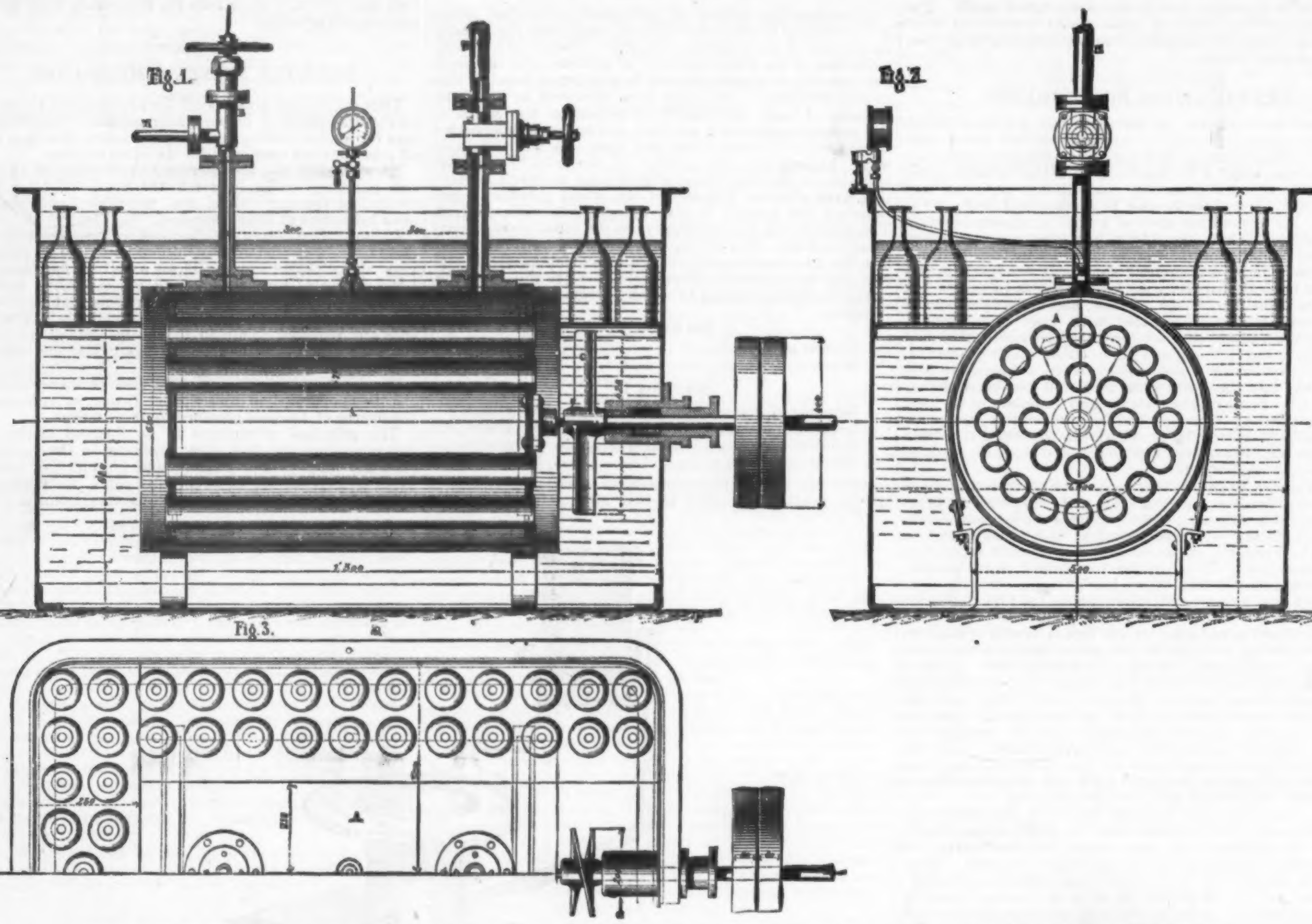


Fig. 1.—THE FREEZER (Longitudinal Section). Fig. 2.—FREEZER (Transverse Section). Fig. 3.—HALF PLAN OF FREEZER.

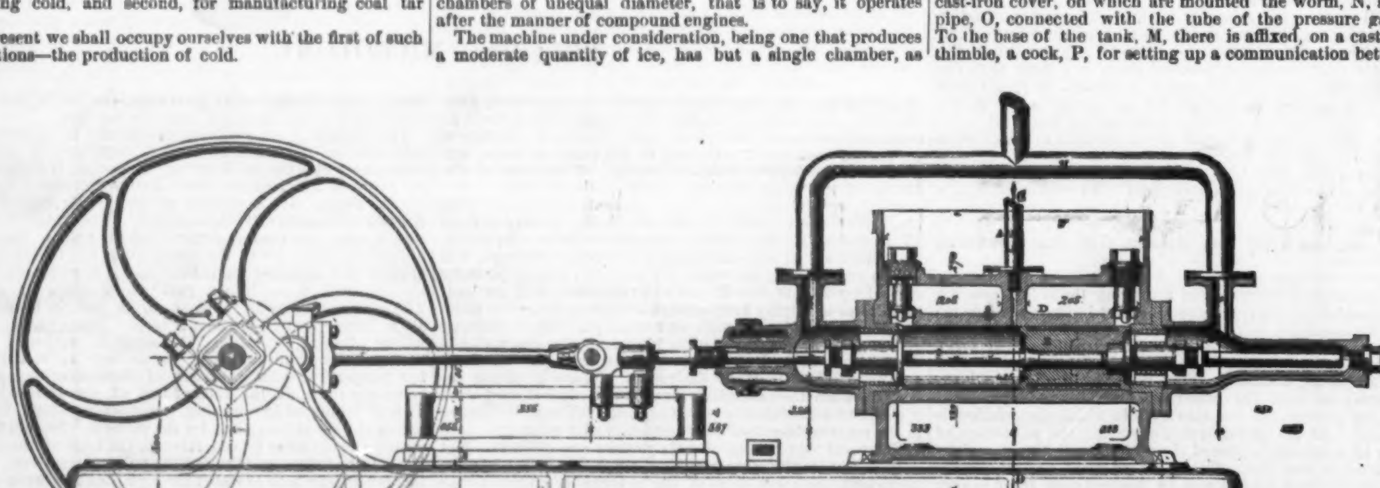


Fig. 4.—THE PUMP (Longitudinal Section).

VINCENT'S ICE MACHINE.

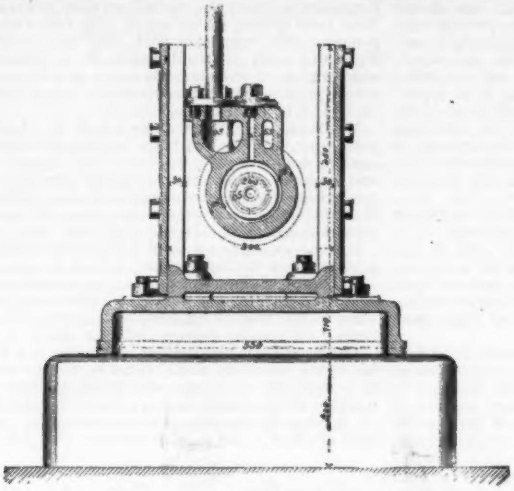


FIG. 5.—VERTICAL SECTION OF THE PUMP.

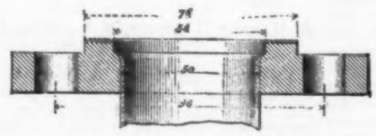


FIG. 8.—SECTION OF FLANGE OF THE WORM.

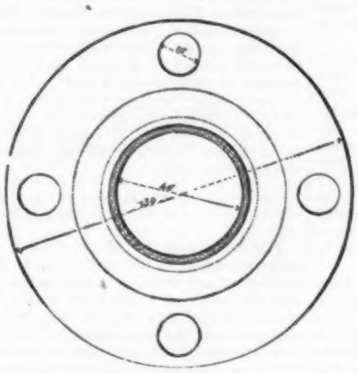


FIG. 9.—VIEW OF THE UNDER SIDE OF THE SAME.

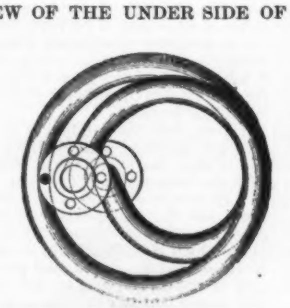


FIG. 10.—PLAN OF THE WORM.

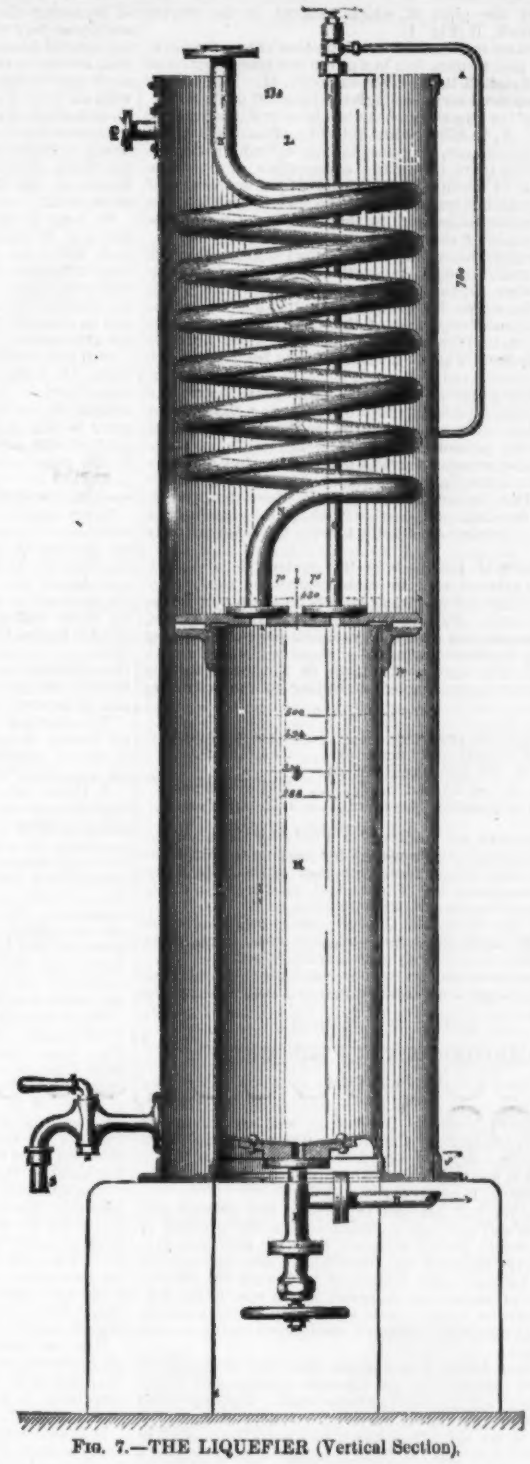


FIG. 7.—THE LIQUEFIER (Vertical Section).

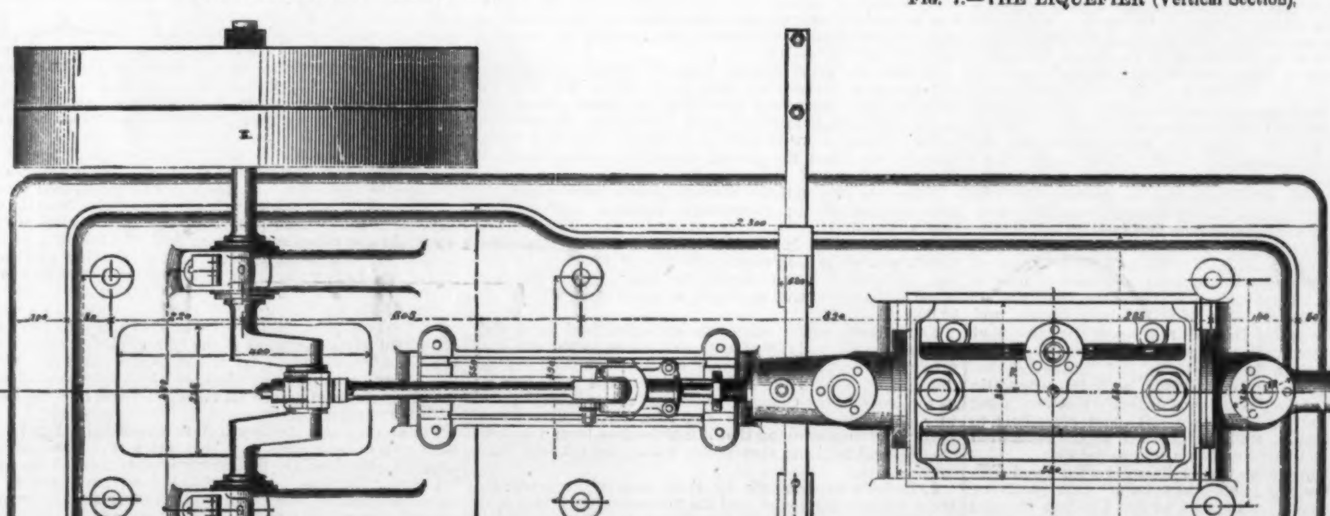


FIG. 6.—PLAN OF THE PUMP.

VINCENT'S ICE MACHINE.

the tank and the pipe, R, which returns to the freezer through the cock, B (Fig. 1).

The cold water requisite for condensation enters the tank, L, through a pipe terminating in a pump or a reservoir. The waste water flows off through the tubulure, Q. The tank is emptied, when necessary, through the blow-off cock, S.

Operation of the Apparatus.—As has been remarked above, the cylinder, A, is filled with chloride of methyl. The pump, through suction, produces in this cylinder a depression from which there results the evaporation of a portion of the chloride of methyl, and consequently a depression of temperature which is transmitted to the incongealable liquid circulating in the tubes, and to the receptacles (carafes or otherwise) containing the water to be converted into ice.

The pump sucks in the vapor of mythyl chloride through the pipe, H, and through its suction valves, and forces it into the chamber, D, through its delivery valves, and from thence into the worm, N, through the pipe, J. Under the influence of compression and of the water contained in the tank, L, the methyl chloride liquefies and falls into the receptacle, M, from whence it returns to the freezer through the pipe, R.

Two pressure-gauges, one of them fixed on the freezer and the other on the liquefier, permit of regulating the running of the machine. The vacuum in the freezer is 0 to ½ atmosphere, and the pressure in the liquefier is 3 to 4 atmospheres. These apparatus make opaque ice, but will likewise produce transparent, if a pump for injecting air is adjoined. This, however, doubles the time that it takes to effect the freezing, and carries with it the necessity of doubling the number of moulds to have the same quantity of ice.

The cost price of ice made by this system depends evidently on the price of coal in each country, on the perfection of the boiler and motor, as well as on the power of the freezing machine. Putting the coal at 20 francs per ton, and the consumption at 2 kilogrammes per horse and per hour, ice may be obtained at a cost of about half a centime per kilogramme. The apparatus shown in the accompanying figures have been constructed according to the following data:

Production of ice per hour..........	25 kilogrammes.
Production of heat units per hour...	2·5 grammes.
Quantity of ice produced per kilogramme of coal burned..........	5 kilogrammes.
Water of condensation per hour.....	0·75 cubic meter.

These machines are employed not only for the manufacture of ice, but also in breweries for cooling the air of the cellars and fermenting rooms, or that of the vats themselves; in manufactories of chemical products; in distilleries; in manufactories of aerated waters, etc.

They may also be used in the carrying of meats and other food products across the ocean, and, in a word, in all industries in which it is necessary to obtain artificial cold.

The power necessary to operate apparatus that produce 25 kilogrammes per hour is about that of 3 horses.—*Annales Industrielles.*

CARBONIC ACID IN THE AIR.*

By M. DUMAS.

OF all the gases that the atmosphere contains, there is one which offers a special interest, as well on account of the part ascribed to it in the mutual interchange going on between the two organic kingdoms, as on account of the relation that it has been observed to occupy between earth, air, and water; this gas is carbonic acid.

Ever since the fact has been established that animals consume oxygen and give out carbonic acid as the product of respiration, while plants consume carbonic acid and give out oxygen, the question has often been asked whether the quantity of carbonic acid contained in the air did not represent a sort of sustaining reservoir which was being continually drawn on by the plants and resupplied by animals, so that it has doubtless remained unchanged owing to this double action.

On the other hand, Boussingault has long since shown that volcanic regions give out through crevices and fumaroles enormous quantities of carbonic acid. The deposition of carbonate of lime that is continually taking place on the sea-bottom is, on the other hand, fixing carbonic acid in quantities which we may accurately estimate from the strata of limestone seen on the surface of the earth. We might imagine, that in comparison with the huge volumes of carbonic acid sent forth in volcanic districts, even in the oldest one, and the mass of carbonate of lime deposited on the sea-bottom, the results attributed to the life of plants and animals would be of no consequence either for increasing or diminishing the physiological carbonic acid in the air comparable with those which are accomplished by the purely geological exchange.

Schloesing has recently succeeded, by a happy application of the principle of dissociation, in showing that the amount of carbonic acid in the air bears a direct relation to the quantity of bicarbonate of lime dissolved in sea water. If the quantity of carbonic acid diminishes, the bicarbonate of the water is decomposed, half of its carbonic acid escapes into the atmosphere, and the neutral carbonate of lime is precipitated. The aqueous vapor condensed from the air dissolves part of the carbonic acid contained therein, and carries it along, when it falls as rain upon the earth, and takes up there enough lime to form the bicarbonate, which is thus carried back to the sea.

The physiological role of carbonic acid, its geognostic influence, and its relations to most ordinary meteorological phenomena on the earth's surface—all these contribute to give special weight to studies concerned in the estimation of the normal quantity of carbonic acid in the air.

Nevertheless, this estimation is attended with great difficulty. Not every one is able to take up such questions, and not all processes are adapted to it. The first thought which would naturally arise would be to inclose a known volume of air in a given vessel, and then determine its carbonic acid by measuring or weighing it. In this way we should obtain the exact relation between a volume of air and the volume of carbonic acid in it, for any given moment, and in any given place. If, however, this be done with a ten-liter flask, for example, it would only hold 3 c. c. of carbonic acid, weighing 6 milligrammes; and, whether it is weighed or measured, the error may easily equal 10 per cent. of the real value, hence no deductions could be drawn from the observed facts.

For this reason larger volumes of air were taken, and a current of air, whose volume could be accurately measured by known methods, was passed through condensers capable of retaining the carbonic acid. But in this case the air must pass very slowly through it, so that the process may last several hours; and since the air is continually in motion, owing to vertical and horizontal currents, the experiment may be begun with the air of one place, and concluded with air from a far distant spot. For example, if an experiment lasting twenty-four hours was made in Paris when the air moved but four meters per second (nine or ten miles per hour), it might be begun with air from the Department of the Seine, and end with air from the Department of the Rhone, or the Belgian frontier, according to the direction of the wind.

So long as we had no analytical methods of sufficient delicacy to estimate with certainty the hundredth, or at least the tenth of a milligramme of carbonic acid, it was very difficult to determine the quantity in the air at a given time and place. It is frequently possible to analyze upon the plain air that has descended from the heights above, and to examine by bright daylight the effect of night upon the atmosphere.

Still other difficulties show themselves in such investigations. It seems very easy to collect carbonic acid in potash tubes, and to determine its amount from the increase in weight of the tubes; but, alas! to how many sources of error is this method exposed. If the potash has been in contact with any organic substance, it will absorb oxygen. If the pumice that takes the place of the potash contains protoxide of iron, it will also absorb oxygen. In both cases the oxygen increases the weight of the carbonic acid.

Every experimenter who has been compelled to repeat the weighing of a somewhat complicate piece of apparatus, with an interval of several hours between, knows how many inaccuracies he is exposed to if he is compelled to take into calculation the changes of temperature and pressure, and the moisture on the surface of the apparatus. After fighting all these difficulties, and frequently in vain, the experimenter begins to mistrust every result that depends only on difference in weight, and to prefer those methods whereby the substance to be estimated can be isolated, so that it can be seen and handled, weighed or measured, in a free state, and in its own natural condition.

The classical experiments of Thenard, of Th. de Saussure, of Messrs. Boussingault, on the quantity of carbonic acid in the air, are well known to every one: they need only to be organized, repeated, and multiplied.

J. Reiset, who has conducted a long and tedious series of experiments on this subject, has adopted a process that seems to offer every guarantee of accuracy. The air that furnishes the carbonic acid is aspirated through the absorption apparatus by two aspirators of 600 liters capacity. The temperature and pressure of the air are carefully measured. The carbonic acid is absorbed by baryta water in three bulb apparatus. The last bulb, which serves as a check to control the operation, remains clear, and proves that no binoxide of barium is formed. The baryta water used is titrated before and after the operation, and from the difference is calculated the quantity of carbonate formed, and hence of the carbonic acid.

These tedious experiments, which varied in duration from 6 to 25 hours, require at least two days of continuous labor. They were repeated 193 times by Reiset in 1872, 1873, and 1879. They were made in still weather, and in violent winds and storms. The air was taken at the sea-shore, in the middle of the fields, on the level earth, during harvests, in the forests, and in Paris. Under such varied conditions, the quantity of carbonic acid varied but little; the numbers obtained were between 2·94 and 3·1, which may be taken as a general average of the carbonic acid in the air.

The quantity of carbonic acid in the free atmosphere is tolerably constant, which must necessarily be the case according to Schloesing's proposed relation between the bi-carbonate of lime in the sea and the carbonic acid in the air. The only cause that seems at all competent to change the geological quantity of carbonic acid in the atmosphere is the formation of fog. As the aqueous vapors condense, they collect the carbonic acid; and the foggy air, as a rule, is more heavily laden with this gas than ordinary air.

It is not surprising that there is less carbonic acid in the air collected on clear summer days, in the midst of clover, etc., that is in an active reducing furnace; if anything is surprising, it is that the quantity of carbonic acid does not sink below 2·8.

It is also a matter for surprise that in Paris, among so many sources of carbonic acid, the furnace fires, the respiration of men and animals, and the spontaneous decomposition and decay of organic substances, the quantity of carbonic acid does not exceed 3·5.

If, then, the great general mean of normal atmospheric carbonic acid deviates but little from 2·9 or 3·0, it is not doubtful that under local conditions, in closed places, and under exceptional meteorological conditions, considerable variations may occur in these proportions. But these variations do not affect the general laws of the composition of the atmosphere.

There are two entirely distinct points from which the measurement of the atmospheric carbonic acid may be contemplated.

The first consists in considering it as a geological element which belongs to the gaseous envelope of the earth in general, and it leads us to express the general relation of carbonic acid to the quantity of air, as about three volumes in 10,000.

The second, which relates to accidental and local phenomena, to the activity of man and beast, to the effect of fires and of decomposing organic matter, to volcanic emanations, and finally to the action of clouds and rain, permits us to recognize the changes which can occur in air exposed to the influences mentioned, and to a certain extent confined. Without denying that it is of interest from a meteorological and hygienic standpoint, it does not take the same rank as first.

J. Reiset's experiments, by their number, accuracy, the large volumes employed, and the interval of years that separate them, have definitely established two facts on which the earth's history must depend: the first is, that the percentage of carbonic acid in the air scarcely changes; the second, that it differs but little from three ten-thousandths by volume.

These results are fully confirmed by the results which were obtained by Franz Schulze, in Rostock, in 1868, 1869, 1870, and 1871. The averages which he got, with very small variation, were 2·8668 for 1869, 2·9052 for 1870, and 3·0126 for 1871.

More recently Muentz and Aubin have analyzed air collected on the plains near Paris, on the Pic du Midi, and on the top of Puy-de-Dome. Their results agree with those published by Reiset and Schulze.

The grand average of carbonic oxide in the air seems to be tolerably fixed, but after this starting-point is established it remains to study the variations that it is capable of, not from local causes, which are of little importance, but from general causes connected with large movements of the air. Upon this study, which demands the co-operation of a definite number of observers stationed at different and distant points of the earth, the experiments being made simultaneously and by comparable methods.

M. Dumas called the attention of the Academy to this point, in connection with its mission of selecting suitable stations for observing the transit of Venus. The process and apparatus of Muentz and Aubin offer the means adapted for making these experiments, and seem sufficient to solve the problem which science proposes, of determining the present quantity of carbonic acid in the air.

If these experiments yield satisfactory results, as we have good reasons to believe they will, it is to be hoped that annual observations will be made in properly-chosen places, so as to determine the variations which may possibly take place in the relative quantity of atmospheric carbonic acid during the coming century.—*Compt. Rend.*, p. 589.

[Although this proposition was made by a Frenchman to his fellow scientists, would it not be well for some American to accept the challenge, and bring it before the coming meeting of the American Association for the Advancement of Science, in the hope that we, too, may contribute our mite of effort in the same direction?—*Ed. Knowledge.*]

* An address before the Paris Academy.

THE INFLUENCE OF AQUEOUS VAPOR ON THE EXPLOSION OF CARBONIC OXIDE AND OXYGEN.*

By HAROLD B. DIXON, M.A., Millard Lecturer in Chemistry, Balliol and Trinity Colleges, Oxford.

Two years ago I had the honor of showing before the Chemical Section of the British Association some experiments, in which a well-dried mixture of carbonic oxide and oxygen was submitted to electric sparks without exploding.† It was further shown that the introduction of a very minute quantity of aqueous vapor into the non-explosive mixture was sufficient to cause explosive combination between the gases when the spark was passed. The hypothesis advanced to account for the observed facts was that carbonic oxide does not unite directly with oxygen at a high temperature, but only indirectly through the intervention of water-vapor present, a molecule of water being decomposed by one of carbonic oxide to form a molecule of carbonic acid and one of free hydrogen, and the latter uniting with the oxygen to re-form a molecule of water, which again undergoes the same cycle of changes, till all the oxygen is transferred to the carbonic oxide:

$$H_2O+CO=H_2+CO_2$$
$$H_2+O=H_2O$$

For such a series of reactions a *comparatively* few molecules of water would suffice, and the change produced by their alternate reduction and oxidation would come under the old term of "catalytic action," inasmuch as the few water molecules present at the beginning are found in the same state at the completion of the reaction.

The truth of this hypothesis has since been confirmed by experiments I have made on the incomplete combustion of mixtures of carbonic oxide and hydrogen; and on the velocity of explosion of carbonic oxide and oxygen with varying proportions of aqueous vapor. I therefore thought a description of the more convenient methods lately devised as lecture experiments for showing the influence of water on the combustion of carbonic oxide would not be uninteresting to the Section.

A glass tube from 18 inches to 2 feet long, closed at one end, and provided with platinum wires, is bent near its open end so that the shorter arm makes an angle of about 60° with the longer arm. The tube, held by a clamp, is heated in a Bunsen flame, and is then filled with mercury heated to about 130° C. The mixture of gases is then made to displace a portion of the mercury by forcing it through a fine tube, which is connected by a steel cap to the eudiometer of McLeod's gas apparatus, and passes down through the mercury in the shorter arm of the experimental tube. When a sufficient quantity of the gaseous mixture has been collected in the longer arm, some dry phosphoric oxide is introduced in the following way: A small glass tube is heated, packed with the dry powder, and pushed down into the shorter arm of the experimental tube. With a hot glass rod the phosphoric oxide is pushed out at the bottom of the small tube, and passes up into the gaseous mixture in the longer arm. After standing for a few hours in contact with the phosphoric oxide, the gases may be submitted to strong sparks from a Leyden jar without igniting. Care must be taken that none of the oxide comes in contact with the platinum wires, for if any sticks to the wires it becomes heated by the passage of the sparks, and gives off enough water to determine the explosion. In this way I have prepared several specimens of a non-explosive mixture of carbonic oxide and oxygen in the proper proportions to form carbonic acid. Some of these tubes have been submitted without explosion to sparks from a large Leyden jar, to a continuous succession of sparks from a Holtz machine, and to the discharge of a Ruhmkorff's coil, that heated the platinum wires between which it passed to bright redness. Other tubes which withstood the passage of the sparks from a Leyden jar, when submitted to the discharge of the coil, exploded after a few seconds when the platinum wires became red-hot. This I think may probably be attributed to hydrogen, occluded by the platinum, being given off on heating, and forming steam with the oxygen present.

For an easy and striking lecture experiment, I employ a tube open at both ends and bent like a W. The two open arms are short and the platinum wires are fixed at the highest bend. The tube is filled with hot mercury—one of the ends being closed by a caoutchouc stopper for the purpose—and a dry mixture of 5 volumes of air and 2 volumes of carbonic oxide is introduced into the bent tube over the mercury. A little phosphoric oxide is passed up one arm. After a few minutes the gases may be submitted to the spark without exploding. A little water may then be introduced through a pipette into the other arm; and if the spark is passed directly the gases ignite in the wet and not in the dry arm of the tube.

The admixture of the inert nitrogen renders a larger quantity of aqueous vapor necessary for the explosion than when only carbonic oxide and oxygen in proper proportion are present.

* Read before the British Association, Southampton Meeting, Section B, 1882.

† "Report of British Association," 1880, p. 503.

COMPOSITION OF BEERS MADE PARTLY FROM RAW GRAIN.

AT the present time English brewers are being denounced for substituting properly-prepared maize, rice, and other raw grain for barley malt, and the beers produced partly from such materials are described as being very inferior, and even injurious to health. That such denunciations are altogether unwarranted is evident to all who have paid any attention to the subject, and are acquainted with the chemical changes involved in brewing, and with the composition of the resulting beers. Unfortunately but few comparative analyses have been published of beers made solely from malt and beers made from malt in conjunction with raw grain, and therefore such wild assertions as were recently uttered in the House of Commons have remained unanswered. A German chemist, J. Hanamann, some time since made a series of analyses of beers brewed partly from raw grain, and his results completely controvert the theory that raw grain beers essentially differ in composition from malt beers. Four worts were made by the decoction system of mashing: A entirely from barley malt; B from 60 per cent. of malt and 40 per cent. of maize; C from 60 per cent. of malt and 40 per cent. of rice; and D from 60 per cent. of malt and 40 per cent. of pure starch. The analyses of these respective worts gave the following results:

	A	B	C	D
Sugar	4·96	4·08	4·84	4·87
Dextrine	6·05	6·83	6·35	6·60
Total extract	12·29	12·27	12·30	12·32
Albuminoids	0·82	0·78	0·68	0·42
Other substances	0·46	0·58	0·43	0·43

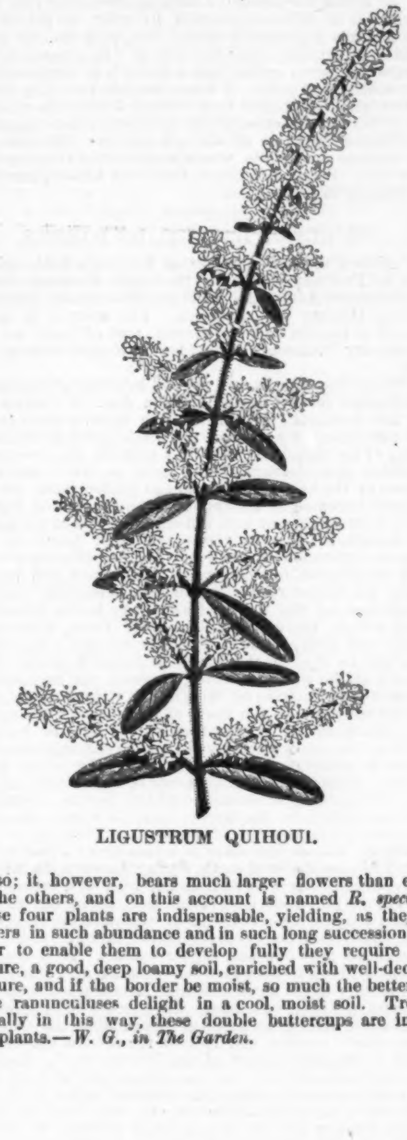
It will be seen that these worts vary very little in composition, the chief points of difference being that those made partly from raw grain are more dextrinous and contain less albuminoids than the wort made from malt alone. The process of brewing was then continued as usual, and after fermentation the resulting beers were again analyzed with the following results:

	A	B	C	D
Alcohol	2·71	2·76	2·90	3·19
Sugar	1·05	1·12	0·98	0·35
Dextrine	4·54	4·31	4·42	4·74
Extract	6·59	6·48	6·25	5·91
Albuminoids	0·43	0·39	0·33	0·28
Other substances	0·57	0·66	0·52	0·54

It will be observed that the beers made partly from raw grain are slightly more alcoholic, but in other respects differ but very little from the pure malt beer, but none of them can in any way be pronounced as really inferior or unwholesome. The beer made partly from maize is, in fact, hardly to be distinguished in chemical composition from that made solely from malt. These worts and beers were brewed upon the German system, but analogous results would undoubtedly be obtained with beers brewed from the like materials on the English system. We hope soon to be in a position to publish some comparative analyses of beers brewed in this country from malt combined with different kinds of raw grain; but the analyses which we have now quoted constitute a sufficient refutation to those who assert that brewers using raw grain are producing an injurious or even an inferior quality of beer.—*Brewers' Guardian.*

DOUBLE BUTTERCUPS.

AMONG early summer flowers in open borders few are prettier than the double-flowered kinds of ranunculus of the herbaceous type. Having been established favorites for ages, most of them are familiar to us, and poor indeed is that hardy plant border which does not contain a good healthy tuft of what are termed Fair Maids of France, or Bachelor's Buttons, the doubled flowered variety of *R. aconitifolius.* The small, pure white rosette-like flowers produced so plentifully, and in such a graceful manner, make it an extremely pretty, and, though common, valuable plant, particularly useful in a cut state. It is one of the kinds shown in the annexed engraving. Of double crowfoots there are three others, the types of which are *R. bulbosus, acris,* and *repens.* All these are very pretty, having bright yellow, compact, rosette-like flowers, as perfect in form as that of some of the finest sorts of the Asiatic or Persian ranunculus of the florists. Both the double *R. acris* and *repens* are profuse flowerers, but *R. bulbosus* is



LIGUSTRUM QUIHOUI.

not so; it, however, bears much larger flowers than either of the others, and on this account is named *R. speciosus.* These four plants are indispensable, yielding, as they do, flowers in such abundance and in such long succession. In order to enable them to develop fully they require good culture, a good, deep loamy soil, enriched with well-decayed manure, and if the border be moist, so much the better, for these ranunculuses delight in a cool, moist soil. Treated liberally in this way, these double buttercups are indeed fine plants.—*W. G., in The Garden.*

LIGUSTRUM QUIHOUI.

THIS is a Chinese species, at present little known in this country. It forms a low bush with spreading wiry purplish downy branches, and loose terminal panicles of white flowers. Its peculiar spreading habit, dark green leaves, and abundant flowers render it a desirable acquisition to the shrubbery. It is quite hardy.—*The Gardeners' Chronicle.*

RAPHIOLEPIS JAPONICA.

THIS handsome Japanese shrub is not an uncommon plant in greenhouses, in which it is generally known under the garden name of *R. ovata.* It is, however, perfectly hardy, and it is with the view of making that fact known that we produce the annexed illustration of it, which represents a spray lately sent to us by Messrs. Veitch from their nursery at Coombe Wood, where the plant has withstood the full rigor of our climate for some years past. The Coombe Wood Nursery is not very well sheltered, and the soil is not of the lightest description; the plant may, therefore, be said to have a fair trial out-of-doors. We have also met with it in the open air in other places besides Coombe Wood, and if we remember rightly, Mr. G. F. Wilson has a fine old bush of it on his rockery which abounds with shrubs of a similar character, all apparently at home. This shrub is of low growth, somewhat bushy in habit, and rather sparsely furnished with oval leaves of a leathery texture. It produces its flowers in early summer, and when a good-sized bush, well covered with clusters of white blossoms resembling those of some species of Cratægus, it has a handsome appearance, and, like most other rosaceous shrubs, powerfully fragrant. Those who possess duplicate plants of it would do well to try it in the open in some sheltered spot, and if in a high and dry position so much the better. This species is called also in the gardens by its synonym, *R. integerrima.* There are three other kinds of Raphiolepis in cultivation, viz., *R. indica, R. rubra,* and *R. salicifolia,* but only the last named one is generally known. It too is a handsome shrub, readily distinguished by the long, willow-like foliage. Its flowers are much the same as those of *R. japonica,* but more plentifully produced. We have no instance of its having stood out like its congener, and we doubt if it is so hardy, seeing that it is a Chinese plant. Perhaps some of our readers can enlighten us on the point.—*W. G., in The Garden.*

RIVINA LÆVIS.

THE brilliant little scarlet berries of this plant render it, when well grown, one of the prettiest of ornaments for the hothouse, conservatory, or even for a warm room. It is quite easily managed, stray seeds of it even growing where they fall, and making handsome specimens. For indoor decoration few subjects are more interesting, and a few plants may be so managed as to have them in fruit in succession all the year round. Any kind of soil will answer for this Rivina. Cuttings of it strike freely, but it is easiest obtained from seeds. Either one plant or three may occupy a 6 in. pot, and that is the best size for table decoration. Usually it is best to raise a few plants every year and discard the old stock, but some may be retained for growing into large specimens. These should be cut back before they are started into growth. The berries yield a fine, but fugitive red color. Miller says that he made experiments with the juice for coloring flowers, and succeeded extremely well, thus making the tuberose and the double white narcissus variegated in one night. Of this species there is a variety with yellow berries which are not quite so handsome as the red, though very attractive. *R. humilis* differs from lævis in having hairy leaves, those of lævis being quite smooth. It also differs in the duller red color of the berries, lævis being much the prettier. Both are natives of the West Indies.—*R. I. L., in The Garden.*

DOUBLE BUTTERCUPS.

FLOWERING SPRAY OF RAPHIOLEPIS JAPONICA.

APPLES IN STORE.

APPLES always, whether in barrels or piles, when the temperature is rising so that the surrounding air is warmer than the apples, condense moisture on the surface and become quite moist and sometimes dripping wet, and this has given the common impression that they "sweat," which is not true. As they come from the tree they are plump and solid, full of juice; by keeping, they gradually part with a portion of this moisture, the quantity varying with the temperature and the circulation of air about them, and being much more rapid when first picked than after a short time, and by parting with this moisture they become springy or yielding, and in a better condition to pack closely in barrels; but this moisture never shows on the surface in the form of sweat. In keeping apples, very much depends upon the surroundings; every variation in temperature causes a change in the fruit, and hastens maturity and decay, and we should strive to have as little change as possible, and also have the temperature as low as possible, so the apples do not freeze. Then, some varieties keep much better in open bins than others; for instance, the Greening is one of the best to store in bins. A very good way for storing apples is to have a fruit-room that can be made and kept at from 32° to 28°, and the air close and pure, put the apples in slatted boxes, not bins, each box holding about one barrel, and pile them in tiers, so that one box above rests on two below, and only barrel when ready to market; but this is an expensive way, and can only be practiced by those with limited crops of apples, and it is not at all practicable for long keeping, because in this way they lose moisture much more rapidly than when headed close in barrels, and become badly shriveled.

All things considered, there is no way of keeping apples quite so good and practicable as packing in tight barrels and storing in cool cellars; the barrel forms a room within a room, and prevents circulation of air and consequent drying and shrinking of the fruit, and also lessens the changes of temperature, and besides more fruit can be packed and stored in a given space than in any other way. The poorest of all ways is the large open bin, and the objections are: too much fruit in contact; too much weight upon the lower fruit; and too much trouble to handle and sort when desirable to market. It was formerly the almost universal custom in Western New York to sort and barrel the apples as fast as picked from the trees, heading up at once and drawing to market or piling in some cool place till the approach of cold weather, and then putting in cellars. By this method it was impossible to prevent leaves, twigs, and other dirt from getting into the bin, and it was difficult to properly sort the fruit, and if well sorted, occasionally an apple, with no visible cause, will entirely and wholly rot soon after packing. Some varieties are more liable to do this than others, but all will to some extent; this occurs within a week or ten days after picking, and, when barreled, these decayed apples are of course in the barrels, and help to decay others. Although packed ever so well and pressed ever so tight, the shrinking of the fresh-picked fruit soon makes them loose, and nothing is so bad in handling apples as this. Altogether this was a very untidy method of handling apples, and has been entirely abandoned for a better.

The very best method depends a good deal upon the quantity to be handled; if only a few hundred barrels, they can be put in open barrels and stored on the barn floor. Place empty barrels on a log-boat or old sled; take out the upper head and place it in the bottom of the barrel; on picking the apples put them, without sorting, directly into these barrels, and when a load is filled, draw to the barn and place in tiers on end along one side of the floor; when one tier is full lay some strips of boards on top and on these place another tier of barrels; then more boards and another tier; two men can easily place them three tiers high, and an ordinary barn floor will in this way store a good many barrels of apples. Where many hundreds or thousands of barrels are grown, it is a good plan to build houses or sheds in convenient places in the orchard for holding the apples as picked; these are built on posts or stones, about one foot from the ground; floors, sides, and ends should be made of strips about four inches wide and placed one inch apart, and the roof should project well on every side. The apples, as picked, are drawn to these in boxes or barrels and piled carefully on the floors, about three feet deep. Where these houses are not provided, the next best way is to pile the apples, as picked, on clean straw under the trees in the deepest shade to be found.

After lying in any one of these positions about ten days they should be carefully sorted and packed in clean barrels, placing at least two layers on the bottom of the barrels, with stems down; after this fill full, shaking moderately two or three times as the filling goes on, and, with some sort of press, press the head down, so that the apples shall remain firm and full under all kinds of handling. Apples may be pressed too much as well as too little. If pressed so that many are broken, and badly broken, they will soon get loose and rattle in the barrels, and nothing spoils them sooner than this. What we want is to have them just so they shall be sure to remain firm, and carefully shaking so as to have them well settled together, has as much to do with their remaining firm as the pressing down of the head. After the barrels are filled and headed they should at once be placed on their sides in a barn or shed, or in piles, covered with boards, from sun and rain, or if a fruit-house or cellar is handy they may at once be placed therein; the object should be to keep them as cool and at as even a temperature as possible. In all the operations of handling apples from picking to market, remember that carelessness and harshness always bruise the fruit, and that every bruise detracts much from its keeping and market value; and remember another thing, that "Honesty is the best policy."
—*J. S. Woodward, in N. Y. Tribune.*

ON DETERMINING THE SUN'S DISTANCE BY A NEW METHOD.

By T. S. H. EYTINGE, Cainsville, Canada.

IT is well known that the sun's distance has been determined from the velocity of light. It has been found, by terrrestrial experiments, about how fast light travels, and, knowing from certain astronomical phenomena the time light requires to pass from the sun to the earth, we have been able to determine the sun's distance.

There are several methods of determining the velocity of light, but hitherto only two plans have been used to detect the time light occupies in passing from the sun to the earth. This time was first discovered by observations of the satellites of Jupiter. It was found that the interval between the eclipses of these bodies was not always the same—that the eclipses occurred earlier when Jupiter was nearest the earth, and later when he was at his greatest distance. Roemer, a Danish astronomer, first detected the cause of this variation. The second method by which this time has been found is the aberration of stellar light. This refined method was detected by the great English astronomer Bradley.

About two years ago it occurred to me that a third method can be used to solve this important problem. My plan is this: It is well known that many variable stars, such as Algol, δ Libræ, U Coronæ, and the remarkable variable D. M. +1 3408, discovered by Mr. E. F. Sawyer, fluctuate at regular intervals. Now, I believe it is possible to determine very accurately the intervals between these changes, and, by noting the change of time in these intervals, when the earth is in different points of its orbit, we get the time light requires to cross that orbit. For, as in the case of the satellites of Jupiter, when the star is "in opposition," the changes will occur earlier than when it is in conjunction or approaching that point. I have recently put this plan to the test, and hope before long to make known the results.

In detecting the changes of variables I have attempted to substitute, in place of the ordinary eye observations, a very delicate thermopile, which registers the changes in the star's heat. So far as I know, this is the first application of the thermopile to variables.

PROFESSOR HAECKEL ON DARWIN.

IN *Nature* appears a report of the remarkable address given by Professor Haeckel at the recent Eisenach meeting of the German Association of Naturalists on the theories of Darwin, Goethe, and Lamarck. The address is mainly devoted to Darwin and Darwinism, and of both, we need scarcely say, Professor Haeckel has the highest estimate. He said:

"When, five months ago, the sad intelligence reached us by telegraph from England that on April 19 Charles Darwin had concluded his life of rich activity there thrilled with rare unanimity through the whole scientific world the feeling of an irreparable loss. Not only did the innumerable adherents and scholars of the great naturalist lament the decease of the head master who had guided them, but even the most esteemed of his opponents had to confess that one of the most significant and influential spirits of the century had departed. This universal sentiment found its most eloquent expression in the fact that immediately after his death the English newspapers of all parties, and pre-eminently his Conservative opponents, demanded that the burial-place of the deceased should be in the Valhalla of Great Britain, the national Temple of Fame, Westminster Abbey; and there, in point of fact, he found his last resting-place by the side of the kindred-minded Newton. In no country of the world, however, England not excepted, has the reforming doctrine of Darwin met with so much living interest or evoked such a storm of writings, for and against, as in Germany. It is, therefore, only a debt of honor we pay if at this year's assembly of German naturalists and physicians we gratefully call to remembrance the mighty genius who has departed, and bring home to our minds the loftiness of the theory of nature to which he has elevated us. And what place in the world could be more appropriate for rendering this service of thanks than Eisenach, with its Wartburg, this stronghold of free inquiry and free opinion! As in this sacred spot 360 years ago Martin Luther, by his reform of the Church in its head and members, introduced a new era in the history of civilization, so in our days has Charles Darwin, by his reform of the doctrine of development, constrained the whole perception, thought, and volition of mankind into new and higher courses. It is true that personally, both in his character and influence, Darwin has more affinity to the meek and mild Melanchthon than to the powerful and inspired Luther. In the scope and importance, however, of their great work of reformation the two cases were entirely parallel, and in both the success marks a new epoch in the development of the human mind. Consider, first, the irrefragable fact of the unexampled success which Darwin's reform of science has achieved in the short space of 23 years! for never before since the beginning of human science has any new theory penetrated so deeply to the foundation of the whole domain of knowledge or so deeply affected the most cherished personal convictions of individual students; never before has a new theory called forth such vehement opposition and so completely overcome it in such short time. The depicture of the astounding revolution which Darwin has accomplished in the minds of men in their entire view of nature and conception of the world will form an interesting chapter in the future history of the doctrine of development."

Describing a visit which he paid to the late Mr. Darwin in 1866, Professor Haeckel says:

"In Darwin's own carriage, which he had thoughtfully sent for my convenience to the railway station, I drove one sunny morning in October through the graceful, hilly landscape of Kent, which, with the checkered foliage of its woods, with its stretches of purple heath, yellow broom, and evergreen oaks, was arrayed in the fairest autumnal dress. As the carriage drew up in front of Darwin's pleasant country-house, clad in a vesture of ivy and embowered in elms, there stepped out to meet me from the shady porch, overgrown with creeping plants, the great naturalist himself, a tall and venerable figure with the broad shoulders of an Atlas supporting a world of thoughts, his Jupiter-like forehead highly and broadly arched, as in the case of Goethe, and deeply furrowed by the plow of mental labor; his kindly, mild eyes looking forth under the shadow of prominent brows; his amiable mouth surrounded by a copious silver-white beard. The cordial, prepossessing expression of the whole face, the gentle, mild voice, the slow, deliberate utterance, the natural and *naive* train of ideas which marked his conversation, captivated my whole heart in the first hour of our meeting, just as his great work had formerly, on my first reading it, taken my whole understanding by storm. I fancied a lofty world sage out of Hellenic antiquity—a Socrates or Aristotle—stood alive before me. Our conversation, of course, turned principally on the subject which lay nearest the hearts of both—on the progress and prospects of the history of development. Those prospects at that time—16 years ago—were bad enough, for the highest authorities had for the most part set themselves against the new doctrines. With touching modesty, Darwin said that his whole work was but a weak attempt to explain in a natural way the origin of animal and vegetable species, and that he should not live to see any noteworthy success following the experiment, the mountain of opposing prejudice being so high. He thought I had greatly overestimated his small merit, and that the high praise I had bestowed on it in my 'General Morphology' was far too exaggerated.

"We next came to speak of the numerous and violent attacks on his work, which were then in the ascendant. In the case of many of those pitiful botches one was, in fact, quite at a loss whether more to lament the want of understanding and judgment they showed or to give the greater vent to the indignation one could not but feel at the arrogance and presumption of those miserable scribblers who pooh-poohed Darwin's ideas and bespattered his character. I had then, as on later occasions, repeatedly expressed my just scorn of the contemptible clan. Darwin smiled at this, and endeavored to calm me with the words, 'My dear young friend, believe me one must have compassion and forbearance with such poor creatures; the stream of truth they can only hold back for a passing instant, but never permanently stem.' In my later visits to Down in 1876 and 1879 I had the pleasure of being able to relate to Darwin the mighty progress which in the past intervals his doctrines had made in Germany. Their decisive outburst happened more rapidly and more completely here with us than in England, for the reason chiefly that the power of social and religious prejudice is not nearly so strong here as among our cousins across the Channel, who are better placed than ourselves. Darwin was perfectly well aware of all this; though his knowledge of our language and literature was defective, as he often complained, yet he had the highest appreciation of our intellectual treasures."

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